Partisol®-FRM Model 2000

PM-2.5 Air Sampler

Operating Manual

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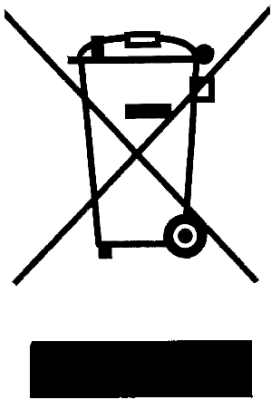
WEEE Compliance

This product is required to comply with the European Union's Waste Electrical & Electronic Equipment (WEEE) Directive 2002/96/EC. It is marked with the following symbol:



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U.S. EPA Reference Method Designation RFPS-0498-117

Notice is hereby given that the EPA in accordance with 40 CFR 40 Part 53 has designated a new reference method for the measuring mass concentrations of particulate matter as PM-2.5 in ambient air. The new reference method is a gravimetric method which utilizes a specially designed PM-2.5 sampler for particle collection the designated method is as follows:

RFPS-0498-117 "Rupprecht & Patashnick Company, Incorporated Partisol-FRM Model 2000 PM-2.5 Air Sampler" operated with software version 1.102 or 1.103, for continuous sample periods, in accordance with the Model 2000 Instruction Manual and with the requirements and sample collection filters specified in 40 CFR Part 50 Appendix L.

This method is available from Rupprecht & Patashnick Company, Inc. (R&P).

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The Partisol stand must be anchored when installed outdoors to prevent tipping of the sampler and/or stand in high winds.

Some assembly of the sample inlet and WINS impactor is required for installation and regular maintenance. Care should be taken when assembling the WINS impactor or inlet to prevent pinching fingers between the assembly parts.

The seller cannot foresee all possible modes of operation in which the user may attempt to utilize this instrumentation. The user assumes all liability associated with the use of this instrumentation. The seller further disclaims any responsibility for consequential damages. Use of this product in any manner not intended by the manufacturer will void the safety protection provided by the equipment, and may damage the equipment and subject the user to injury.

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Equipment Rating

The following information can be used to determine the power service requirements of this product.

Line Voltage
115 V ~ 60 Hz 380 VA
230 V ~ 50 Hz 380 VA

IMPORTANT: Disconnect the power cord from the power source (output) while servicing the instrument to prevent electrical hazard.

Only reach as far as needed to adjust the mass flow controller (MFC) in the pump compartment. There may be a hazardous line (wire) accessible in the rear of the pump compartment.

There are two fuses in the transformer wiring harness. Both fuses are in the Secondary of the Transformer. The fuse values are T 4A 250V and T 5A 250V.

FUSE TABLE

Reference designation	Fuse	Location
Transformer Secondary	T 4A 250V	Transformer Wiring Harness
Transformer Secondary	T 5A 250V	Transformer Wiring Harness

Environmental Ranges — The instrument operates effectively in the following temperature range: -40° to 50° C.

NOTE: If the user operates the instrument in temperatures below -25° C, the unit may require an optional insulating jacket. Contact R&P for further information.

Installation Category — Category 11

Electrical & Safety Conformity

This product has been tested by Intertek Testing Services, and has been documented to be in compliance with the following U.S. and Canadian standards:

UL Standard 3101-1
CAN/CSA C22.2 NO. 1010.1

Rupprecht & Patashnick Co., Inc. certifies that this product operates in compliance with the EC Directive 89/336/EEC in reference to electrical emissions and immunity. Specifically, the equipment meets the requirements of EN50081-1:1992, Class B (Emissions) and EN50082-1:1997 (Immunity).

In addition, the hardware has been tested for personal or fire safety hazards, and meets the requirements of EN61010-1 (Safety) in fulfillment of EC Directive 73/23/EEC.

U. S. EPA Quality Assurance Specifications

The operating manual includes references to U.S. EPA 2.12 Quality Assurance Handbook Volume II, Part II. Partisol-Plus Model 2025 Air Samplers which are installed as part of a U.S. EPA monitoring network, or which must meet U.S. EPA monitoring requirements must follow the procedures found in the 2.12 Quality Assurance Handbook. If there is any conflict between the instructions or procedures in this operating manual and those found in the 2.12 Quality Assurance Handbook, the 2.12 specifications and procedures take precedence.

A copy of U.S. EPA 2.12 Quality Assurance Handbook may be obtained from the AMTIC web site: http://www.epa.gov/ttn/amtic/pmqa.html or the QC coordinator at any EPA Regional Office, or the Monitoring and Quality Assurance Group (MD-14), U.S. EPA, Research Triangle Park, NC 27711.

Section Revision List

As R&P instrumentation changes, so do our operating and service manuals. However, these changes may affect only one aspect of an instrument, while leaving the instrument as a whole unchanged. To explain these individual changes to our customers, R&P will update only those sections of its operating and service manuals that are affected by the instrument updates or improvements. As each manual section changes, so does its revision number, which is located at the top right corner of each page of each section.

To help our customers keep track of the changes to the Partisol-FRM Model 2000 PM-2.5 Air Sampler and its operating manual, following is a list of the manual sections with their respective revision numbers:

Section Number and Description	*Revision Number*
Section 1: Introduction	B.002
Section 2: Hardware Installation	B.002
Section 3: Filter Handling and Exchange	B.001
Section 4: Software Overview	B.001
Section 5: Software Setup and Operation	B.003
Section 6: Sampler Operation	B.001
Section 7: On-Screen Operating Information	B.001
Section 8: Viewing and Transmitting Stored Data	B.001
Section 9: Data Output	B.000
Section 10: Routine Maintenance and Verification Procedures	B.002
Section 11: Calibration Procedures	B.001
Section 12: Resetting the Sampler	B.000
Appendix A: Overview of Software Screens	B.001
Appendix B: Program Register Codes	B.001

Section Revision List continued

Section Number and Description	*Revision Number*
Appendix C: Hardware Connections	B.000
Appendix D: Two-Way Serial Communication	B.000
Appendix E: Installing New System Software	B.001
Appendix F: Consumables and Parts	B.001
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Section 1: Introduction

The Partisol-FRM Model 2000 PM-2.5 Air Sampler (Figure 1-1) is designed to conform to the U.S. EPA Federal Reference Method for fine particulate sampling. Specifically, Rupprecht & Patashnick (R&P) has designed the hardware to exceed or meet the requirements of CFR 40 Part 50 Appendix L and related drawings supplied by the U.S. EPA.

This addition to the Partisol family of samplers builds upon the extensive experience gained by R&P in the design and manufacture of the original Partisol PM-10 Air Sampler. This popular sampling platform holds the U.S. EPA reference designation for PM-10 sampling. Many of the design features adopted by the U.S. EPA in the proposed PM-2.5 Federal Reference Method were first introduced into a reference-designated air sampling method by R&P in the original Partisol Sampler. These include the following:

- A flow rate of 1 m^3/h through a single filter.
- The use of standard 47 mm sample filters with a convenient filter exchange mechanism.
- Full microprocessor control and data handling.
- Active volumetric flow control.

✔ The Partisol-FRM Sampler builds upon the features first introduced with the original Partisol PM-10 Air Sampler.

Figure 1-1. Partisol-FRM Model 2000 PM-2.5 Air Sampler.

The Partisol-FRM Sampler contains the U.S. EPA-designed PM-2.5 WINS Impactor, which performs a 2.5 μm cut of the incoming particulate matter before the sample stream passes through a 47 mm filter. A modified R&P PM-10 (1st stage) inlet is used at the entrance to the sampler to provide a pre-cut at a 10 μm particle size and to protect the sample path against precipitation.

The hardware also contains a straightforward filter exchange mechanism, a microprocessor with battery-backed internal data storage, an active volumetric flow control system, and a pump. A fan located in the filter compartment is constantly turned on to ensure that the temperature of the sample filter does not deviate by more than 5 °C from the ambient air temperature. Menu-driven software provides convenient access to sampler functions.

As with other manual sampling devices, the filters used in the Partisol-FRM Sampler must be conditioned and weighed before exposure, and then conditioned and weighed again after use to determine the mass of the particulate matter collected during the 24-hour exposure time. The Partisol hardware stores the data relevant to each 24-hour collection period in its

internal data logger for viewing and/or retrieval after the fact. Such information includes the total volume sampled (in volumetric m^3), total collection time, and the average ambient temperature and pressure during the collection period. In addition, the device stores interval data records every five minutes to keep a record of the temperature of the ambient air and sample filter.

1.1. ADVANCED FEATURES

The following is a listing of some of the advanced features contained in the Partisol-FRM Air Sampler:

- Simplicity of operation, performance audits, and retrieval of stored data are made possible through an embedded microprocessor and menu-driven software.

- An active volumetric flow control system maintains a constant volumetric flow rate at the level specified by the user (default of 16.7 l/min) by incorporating a mass flow controller, and ambient temperature and pressure sensors. Sampled volumes are reported in volumetric terms to conform with U.S. EPA requirements.

- The U.S. EPA-designated PM-2.5 inlet system provides a 2.5 µm cut point by incorporating a 1st stage inlet at the entrance to the hardware and a PM-2.5 WINS impactor inside its enclosure.

✔ Single-filter trays simplify filter exchange and transportation, and minimize the chances of fingers coming into contact with the 47 mm collection filters.

- The sampler uses standard 47 mm filters housed in convenient reusable cassettes. These cassettes are mounted in a single-filter tray for easy exchange and transportation to and from the sampling site.

- The temperature of the collection filter is maintained within 5 °C of the outdoor ambient temperature by a continuous filter compartment ventilation system.

- Interval data are stored every five minutes, and include the five-minute averages of the filter temperature, ambient temperature, and ambient pressure. Data storage continues both during and after the exposure of the collection filter. The sampler has a capacity of 14 days of five-minute interval data.

- A record of filter data is stored for each filter used in the device, and includes all U.S. EPA-specified values such as the volume sampled, error condition flagging, and average temperatures and pressures. The sampler has a capacity of 25 filter data records.

- Low maintenance requirements are made possible through the use of durable components and a proven, long-life vacuum pump.

- The sampler is easily transported due to its compact form and lightweight design. Its low noise level makes it appropriate for indoor monitoring.

- The sampler ships with UL-, CSA- and CE-equivalent electrical and safety approvals.

- An analog output of 0-5 VDC indicates the current flow rate and the existence of any status conditions.

- A bidirectional RS232 interface for data transfer to or from a PC or other digital device allows interval and filter data to be retrieved conveniently. The sampler's standard configuration includes basic PC-based communication software for bidirectional information exchange with the system.

1.2. ORGANIZATION OF MANUAL

This manual is divided into sections, with each treating a different topic. The first parts deal with the setup of the system's hardware and software, while the later sections describe the more-advanced features of the Partisol-FRM Sampler. The user should read and implement the procedures discussed in the earlier sections before using the functions detailed later in the manual. The following listing provides an overview of the topics handled in each section of this manual:

Section 1: Introduction
This section introduces the user to the advanced features of the Partisol-FRM Sampler and describes the flow configuration of the system. It also discusses the flow control scheme used in the hardware.

Section 2: Hardware Installation
This section sets forth the instructions for setting up the sampling hardware, along with its optional stand.

Section 3: Filter Handling and Exchange
This section describes the handling of the 47 mm collection filters used in the Partisol system, from the initial conditioning of the filter, to the installation of filter trays in the sampling system, to the post-collection conditioning and weighing of the filter. This part also describes how to compute the average particulate concentration based upon the initial and ending filter weights, and the total volume drawn through the filter.

Section 4: Software Overview
This section provides an overview of the hierarchy of system screens, along with the instructions for navigating around the software and changing the values of parameters.

Section 5: Software Setup and Operation
This section describes the operation of the Partisol-FRM Sampler, including the definition of its sampling program.

Section 6: Sampler Operation
This section describes the steps involved in verifying the sampler performance characteristics prior to starting a sampling run, programming a sampling run and retreiving data after a sampling run.

Section 7: On Screen Operating Information
The Partisol-FRM Sampler displays a variety of information regarding the state of the system, ranging from status codes to screens that display the current values of operating parameters. This section details the types of diagnostic information available to the user.

Section 8: Viewing and Transmitting Stored Data
Interval and filter data stored internally may be viewed on the sampler's screen, or may be downloaded through the RS232 port. This section describes the type of operational information stored internally, as well as the means by which this information can be transmitted to external devices.

Section 9: Data Output
The Partisol-FRM Sampler transmits current flow rate and operational information through an analog output channel, and can provide digital data through its bidirectional RS232 port. This section provides the information necessary to make effective use of these data output possibilities.

Section 10: Routine Maintenance and Verification Procedures
This section describes the steps taken to verify the sampler's performance, as well as the procedures involved in maintaining the consistent operation of the hardware.

Section 11: Calibration Procedures
This section sets forth the procedures involved in calibrating the ambient temperature sensor, ambient pressure sensor, filter temperature sensor, and the automatic mass flow controller of the sampler.

Section 12: Resetting the Sampler
This section describes the means by which the user can reset the instrument's parameter set points and internal data storage.

Appendix A: Overview of Software Screens
This appendix displays the menu tree of the Partisol-FRM Sampler, as well as all display screens of the software.

Appendix B: Program Register Codes
All important system variables, parameters and current results are stored in so-called "Program Register Codes" (PRCs). These codes, which are listed in this appendix, are important when communicating with the sampler remotely through its RS232 interface.

Appendix C: Hardware Connections
This appendix describes the hardware pin-outs of the data connectors incorporated in the sampler.

Appendix D: Two-Way Serial Communication
This appendix describes the two-way serial communication capabilities of the hardware.

Appendix E: Installing New System Software
This appendix sets forth the manner in which EPROM's are replaced in the Partisol-FRM hardware.

Appendix F: Consumables and Parts
This appendix contains a list of consumables and spare parts available for the Model 2000 sampler.

Appendix G: Filter Log
This appendix contains a filter log that can be employed as a quality assurance tool to track the history of each filter used in the sampler.

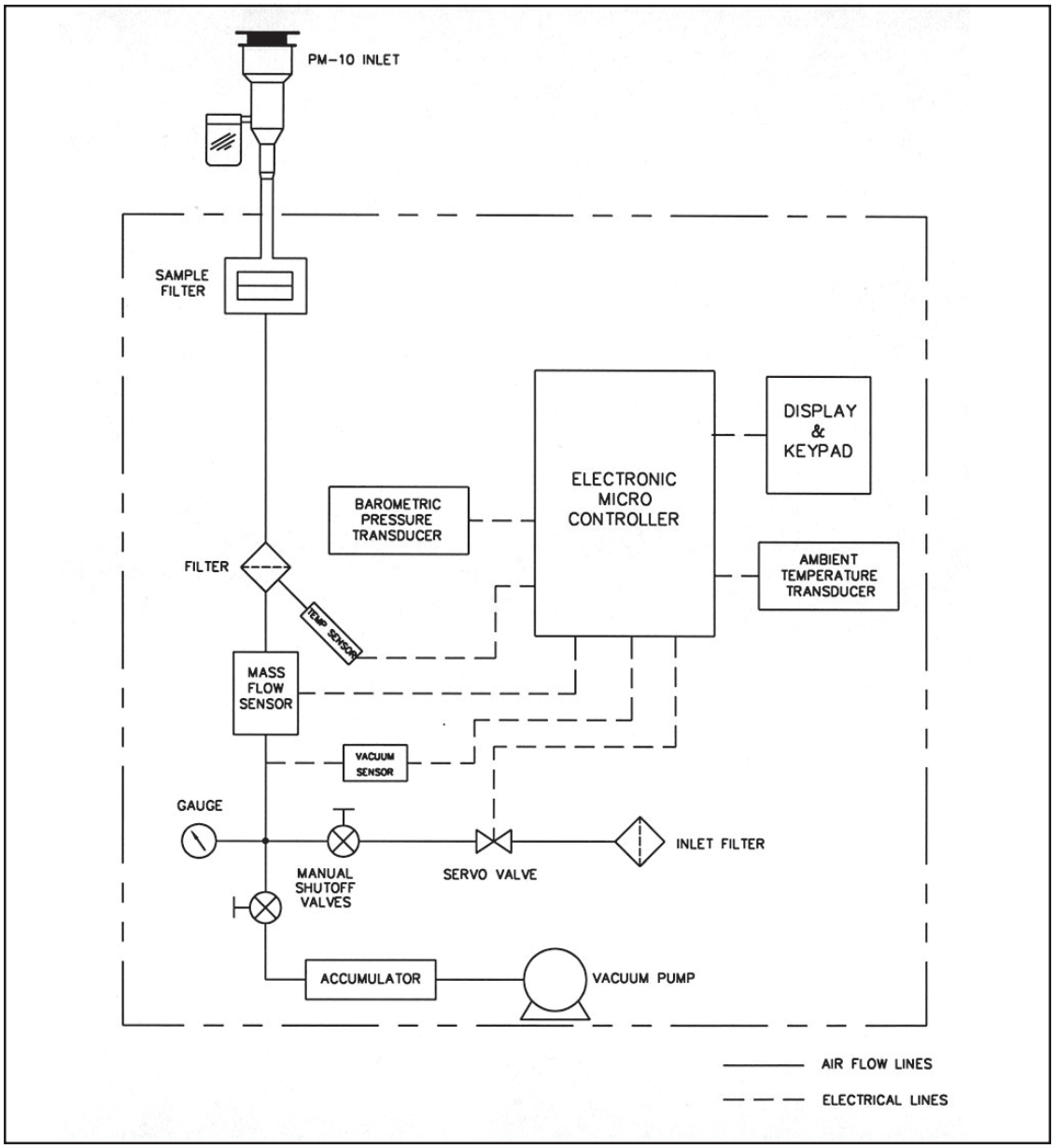
Appendix H: Inlet Maintenance
This appendix describes the maintenance procedures for the PM-10 inlet and PM-2.5 WINS impactor.

Appendix I: Inlet Conversion
This appendix describes the components of the PM-2.5 WINS impactor sampler configuration and the PM-10 sampler configuration, and the procedures for converting the Partisol-FRM from a PM-2.5 to a PM-10 sampler.

1.3. FLOW SCHEMATIC

The system flow schematic provides an overview of the hardware's flow and electronic connections (Figure 1-2). The schematic shows a PM-10 inlet that is followed by a down tube and WINS PM-2.5 Impactor. The WINS Impactor is located inside the sampler enclosure. A 47 mm Teflon filter is housed in a filter cassette that the user installs in a single-filter tray. The tray makes the easy exchange of filters possible in the sampler's filter exchange mechanism, and minimizes the chances of fingers coming into contact with the collection filter.

Figure 1-2. System flow schematic.



✔ The Partisol-FRM Sampler actively maintains a constant volumetric flow rate at the user-defined set point (16.7 l/min by default).

An in-line filter downstream of the sample filter protects the mass flow controller from any particles that may remain in the air flow. The mass flow controller operates under the control of the sampler's microprocessor, and maintains the sample stream at a constant *volumetric* flow rate (16.7 l/min default) through the use of ambient temperature and pressure sensors. The accumulator minimizes pulsations caused by the vacuum pump, while the pump built into the Partisol-FRM Sampler is the same highly-reliable model built into the original Partisol Model 2000 Air Sampler.

The Partisol-FRM Sampler maintains a constant volumetric flow rate at the set point entered by the user (usually 16.7 l/min), and reports sampled volumes (m^3) in volumetric terms in accordance with new U.S. EPA guidelines.

The sampling system determines the ambient temperature and pressure for flow rate calculations through the use of sensors that continually provide updated information to the microprocessor system.

The mass flow controller in the Partisol-FRM Sampler is calibrated at a temperature of 0 °C and pressure of 1 atmosphere (1013.2 millibars or 760 mm Hg). For the device to sample at the correct volumetric flow rate, it makes use of the measured ambient temperature and pressure. Using this information, the microprocessor calculates the correct mass flow set point (Flow Rate_{STP}) required to achieve the desired volumetric flow setting:

$$\text{Flow Rate}_{STP} = \text{Flow Rate}_{Vol} \times \frac{273.15}{\text{Ave Temp} + 273.15} \times \frac{\text{Ave Pres}}{760}$$

where:

Flow Rate_{STP} = Control set point of the mass flow meter (equivalent flow at 0 °C and 1 atmosphere).

Flow Rate_{Vol} = Volumetric flow rate set point (l/min) as entered by the user in the Setup Screen (Section 5). This value is 16.7 l/min (1 m^3/h) for most applications.

Ave Temp = The current temperature (°C) as measured by the temperature sensor mounted on the down tube of the sampler.

Ave Pres = The current pressure (mm Hg) as measured by the pressure transducer in the sampler's enclosure.

Mass concentration data reported to the U.S. EPA must be in volumetric m^3, which simply involves integrating the above volumetric flow rate over the sampling period, without any further adjustment. The Partisol-FRM Sampler automatically determines the sampled volume in volumetric m^3 for each filter exposed, and stores this information internally for later viewing or downloading (Section 7).

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Section 2: Hardware Installation

This section describes the installation of the Partisol-FRM Sampler, along with the setup of the optional support stand. This part also covers a number of operational considerations.

2.1. Standard Hardware Configuration

The following is a listing of the standard components provided with a Partisol hub unit:

Partisol-FRM enclosure with WINS PM-2.5 impactor and filter exchange mechanism
PM-10 sample inlet
3 rain hoods and associated hardware
Sample tube
Ambient temperature sensor and cable
Dual filter transport container with cassettes and carriers
Flow audit adapter
Box of 25 glass filters, 37 mm diameter
Bottle of WINS impactor oil, 30 ml
Analog input calibration cable
Mating cable connector for four-pin user-output connector
AKCOMM software diskette
9-to-9 pin computer cable
2 Operating Manuals
1 Service Manual
1 Quick Start Guide

2.2. Setting Up the Sampler

Follow the procedure below to set up the hub unit:

NOTE: The Partisol-FRM Sampler should be fitted with its optional insulating jacket (10-004146) in the wintertime for locations at which temperatures are expected to drop below -30 °C on a regular basis. Refer to Appendix F for a complete listing of part numbers.

1) When moving the instrument, be sure to lift the unit by using the two handles.

2) Cut any tie wraps and remove any transport restraints from inside the sampler enclosure.

3) Install the large rain hood on the right side of the enclosure (Figure 2-1). The rain hood should cover both air filters.

a) Peel back the paper facing of the larger gasket and apply it to the larger rain hood.

b) Place the large rain hood with its gasket attached on the enclosure.

c) Secure the rain hood to the unit using four (4) #10-32 x 1/2" thumb screws.

Figure 2-1. Partisol-FRM Sampler with a small rain hood (left) and a large rain hood (right).

4) Install the two small rain hoods (Figure 2-1). One rain hood is installed on the left side of the enclosure and the other on the back. Each rain hood covers one fan opening.

a) Peel back the paper facing of one of the smaller gaskets and apply it to one of the smaller rain hoods.

b) Place the small rain hood with its gasket attached hood on the enclosure.

c) Secure the rain hood to the unit using four (4) #10-32 x 1/2" thumb screws.

d) Repeat this procedure for the other small rain hood.

5) Install the sample tube and PM-10 inlet (Figure 2-2).

NOTE: Examine the sample tube. Some sample tubes are machined down to a smaller diameter on both ends. The machining on one end extends for 5 cm (2 inches), while the machining on the opposite end extends only 3 cm (1.25 inches).

a) Insert the end of the sample tube with the 5 cm (2 inches) machined section into the bulkhead of the sampler. Ensure that the tube is pushed into the enclosure through the final O-ring until it hits a stop.

b) Turn the dome connector on the bulkhead to ensure a tight grip.

c) Place the PM-10 inlet on the end with 3 cm (1.25 inches) of machining. Ensure that the tube is pushed past the inlet's two O-rings, which provide some resistance, and hits a stop.

In its final sampling configuration, the entrance to the inlet must be approximately 2 m above the ground (6 to 7 feet). An optional stand (57-004644) described in Section 2.3 provides a convenient means of installing the sampler.

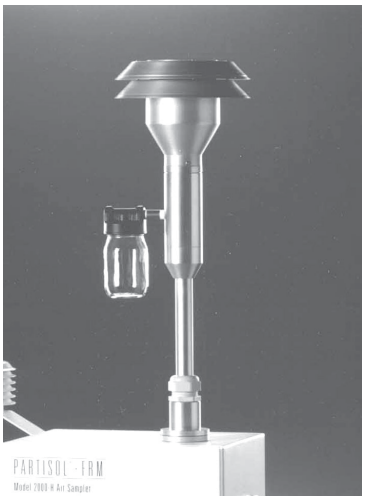


Figure 2-2. Sample tube with the modified PM-10 inlet installed.

6) Connect the hub to the electric supply in a manner that meets all safety and regulatory requirements for the hardware's intended use.

The wires inside the power cord are defined by the following colors, which are different for 115 and 230 VAC configurations:

	115 VAC	*230 VAC*
Line	Black or Brown	Brown
Neutral	White or Blue	Blue
Common Ground	Green or Green/Yellow	Green/Yellow

For *115 VAC configurations* of the Partisol system, the standard three-pronged U.S. plug is provided at the end of the power cord. This plug is intended only for some types of indoor installations, and may have to be replaced by other connecting hardware for certain types of indoor and outdoor locations to meet electrical and other safety requirements.

WARNING: Use of the supplied 115 VAC three-prong plug out of doors or in and uncontrolled interior environment may present a severe electrical shock hazard.

For *230 VAC configurations* of the Partisol system, the standard two-pronged European plug is provided at the end of the power cord. This plug is intended only for some types of indoor installations, and may have to be replaced by other connecting hardware for certain types of indoor and outdoor locations to meet electrical and other safety requirements.

WARNING: Use of the supplied 230 VAC two-prong plug out of doors or in and uncontrolled interior environment may present a severe electrical shock hazard.

7) Install the ambient temperature sensor.

a) Locate the two screws installed on the left side of the enclosure.

b) Remove the two screws, being careful not to lose the washers, if installed. This will expose two holes.

c) Locate the ambient temperature probe assembly in the compilation package.

d) Place the ambient temperature probe assembly over the two holes in the left side of the sampler enclosure (Figure 2-3).

Figure 2-3 (left). Ambient temperature probe assembly mounted on the enclosure.

Figure 2-4 (right). Ambient temperature probe plugged into the "TEMPERATURE SENSOR" connector.

e) If R&P supplied the sampler with washers, secure the assembly to the enclosure using the screws and washers previously removed. Place the washers between the ambient temperature bracket and the enclosure – *not under the head of the screw* – then insert the screws into the bracket. The washers provide a watertight seal to prevent leakage of water into the electronics compartment.

f) If R&P supplied the sampler without washers, secure the assembly to the enclosure using the screws previously removed. In this case, leak tightness is achieved on the inside of the electronics compartment through the use of self-sealing components.

g) Plug the ambient temperature probe into the connector on the back panel of the sampler labeled "TEMPERATURE SENSOR" (Figure 2-4).

8) Prepare the WINS PM-2.5 impactor for use (Appendix H).

9) Install a 47 mm filter in the sampler (Section 3). Ensure that the sampler is not powered up.

10) After the system is powered up according to the instructions in Section 4, perform the leak check described in Section 10.2.

2.3. PARTISOL STAND

The Partisol Stand (R&P part number 57-004644) aids in the installation of the Partisol-FRM Sampler, and ensures that the inlet is at the appropriate height. Figure 2-5 shows the mounting of the unit on the stand.

> **WARNING:** The Partisol-FRM stand must be anchored or otherwise secured at the monitoring site. The Partisol-FRM/ Stand could present a tipping hazard in high wind conditions if the stand is not properly anchored.

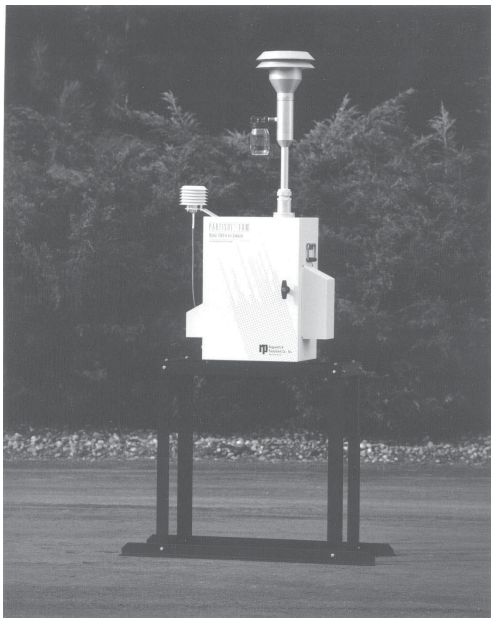
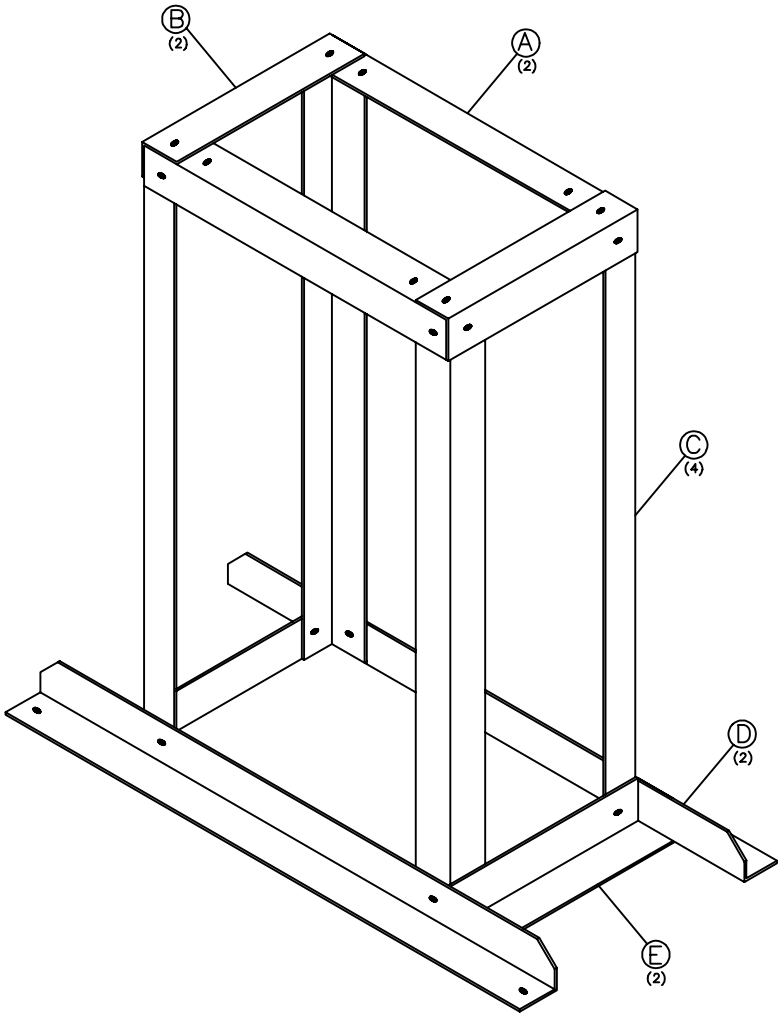


Figure 2-5. Partisol-FRM Sampler mounted on optional stand.

Figure 2-6 contains a listing of parts, as well as other assembly information for the stand. Put this hardware together in accordance with the diagram shown in this figure.

Figure 2-6. Assembly information for the optional Partisol Stand.

INSTRUCTIONS, PARTISOL STAND ASSEMBLY



ITEM	QTY	PART NUMBER	DESCRIPTION
A	2	36-002445	PARTISOL STAND, TOP FRONT AND BACK
B	2	36-002444	PARTISOL STAND, TOP LEFT AND RIGHT
C	4	36-002446	PARTISOL STAND, LEGS
D	2	36-002471	PARTISOL STAND, BOTTOM FRONT AND BACK
E	2	36-002472	PARTISOL STAND, BOTTOM LEFT AND RIGHT
F	20	21-001291-0012	HEX HEAD BOLT, 1/4-20 x 3/4 LONG
G	24	21-001275	FLAT WASHER, 1/4
H	4	21-000907-0006	SOC BUTTON HEAD SCREW, 1/4-20 x 3/8 LONG

NOTE: HARDWARE ITEMS F AND G ARE USED FOR STAND ASSEMBLY
HARDWARE ITEMS G AND H ARE USED TO SECURE HUB OR SATELLITE TO STAND

2.4. HARDWARE CONSIDERATIONS

✔ A fan and heater provide cooling and heating for the sampler.

A number of systems internal to the Partisol-FRM Sampler are designed to maintain acceptable operating conditions within the hardware.

Based upon the temperature measured on the interface circuit board in the electronics compartment, the device either turns on a cooling fan if temperatures become warm or turns on a heater if temperatures drop. This is done according to the following rules.

- The cooling fan in the pump compartment turns on if the temperature measured on the interface board exceeds 30° C, and turns off again once the temperature falls below 25° C.

- The heater in the electronics compartment turns on if the temperature measured on the interface board drops below 15° C, and turns off again once the temperature rises above 20° C.

The sample pump is always on when sampling takes place. When the device is not sampling, the sample pump turns on under the cold-weather conditions listed below. In such a case, the flow through the pump enters the system through a valve that regulates the bypass stream to the flow controller.

- The pump turns on continuously if the ambient temperature falls below -5 °C, and turns off again once the ambient temperature reaches 10° C.

If the temperature measured on the interface board drops below a certain level, the system electronics cannot be guaranteed to operate reliably, and the device enters a standby condition. This occurs according to the following rule:

- If the temperature measured on the interface board drops below -5° C, a standby condition is invoked in which the pump and heaters are turned on continuously until the temperature rises above this level. The system microprocessor is turned off during this standby state.

2.5. Adjusting the Liquid Crystal Display (LCD)

Turn the knob on the on the lower left-hand side of the keypad to adjust the contrast of the sampler's liquid crystal display. This knob may be turned both clockwise and counterclockwise (Figure 2-7).

Figure 2-7. LCD contrast adjustment knob.

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Section 3: Filter Handling and Exchange

This section covers the initial inspection of 47 mm filters used in the Partisol-FRM Sampler, as well as the equilibration and weighing before and after use. Further, it covers their installation and removal in the sampling unit, as well as the computation involved in calculating the 24-hour mass concentration average of PM-2.5 as found in U. S. EPA 2.12 Quality Assurance Handbook Volume II, Part II Section 7 (Filter Preparation and Analysis, Section 8 (Field Operation) and Section 11 (Calculations, Validation and Reporting of PM2.5 Monitoring Data). Use the filter log in Appendix G as an aid in record keeping.

3.1. Filter Handling and Initial Inspection

The only filter media currently approved by the U.S. EPA for reference method sampling of PM-2.5 in the proposed regulations is Teflon material in a 47 mm diameter size. This is available from R&P in the following form:

✘ Never touch filters with fingers.

Teflon Filters, 2.0 μm pore size, Box of 50 R&P part number 10-002322-0050

The user must be careful to keep filters clean and never to touch filters with fingers. Filters should be stored at the laboratory in petri dishes, and should be transported to and from the sampling site in the filter transport system supplied by R&P. *Only non-serrated forceps should be used to handle the 47 mm filters used in the sampler.*

Inspect each filter visually for integrity before use. Check for the following:

- Pinholes
- Chaff or flashing
- Loose material
- Discoloration
- Non-uniformity

3.2. Initial Filter Equilibration

Perform this procedure to equilibrate 47 mm filters before use. Be sure to use petri dishes to store filters in the laboratory.

Follow these steps to equilibriate filters before sampling:

NOTE: Refer to the U.S. EPA 2.12 Quality Assurance Handbook, Section 7, for further information.

1) **Place a label on the cover of each petri dish and number each dish.**
2) **Place the petri dish cover *under* the bottom half of the dish.**
3) **Place each inspected filter into a separate petri dish.**
4) **Record the filter number, relative humidity, temperature, date and time at the beginning of equilibration.**
5) **Equilibrate each filter for *at least* 24 hours under the following conditions:**

   The equilibration room must be held at a constant relative humidity between 30 and 40% with a variability of not more than ±5% relative humidity.

   The equilibration room must be held at a constant temperature between 20 and 23 °C with a variability of not more than ±2 °C.

3.3. Initial Filter Weighing

Follow this procedure to weigh the 47mm collection filters (tare weight) before sampling.

Follow these steps to weight the collection filters before sampling:

NOTE: Refer to the U.S. EPA 2.12 Quality Assurance Handbook, Section 7, for further information.

✔ Record the initial filter weight as W_i.

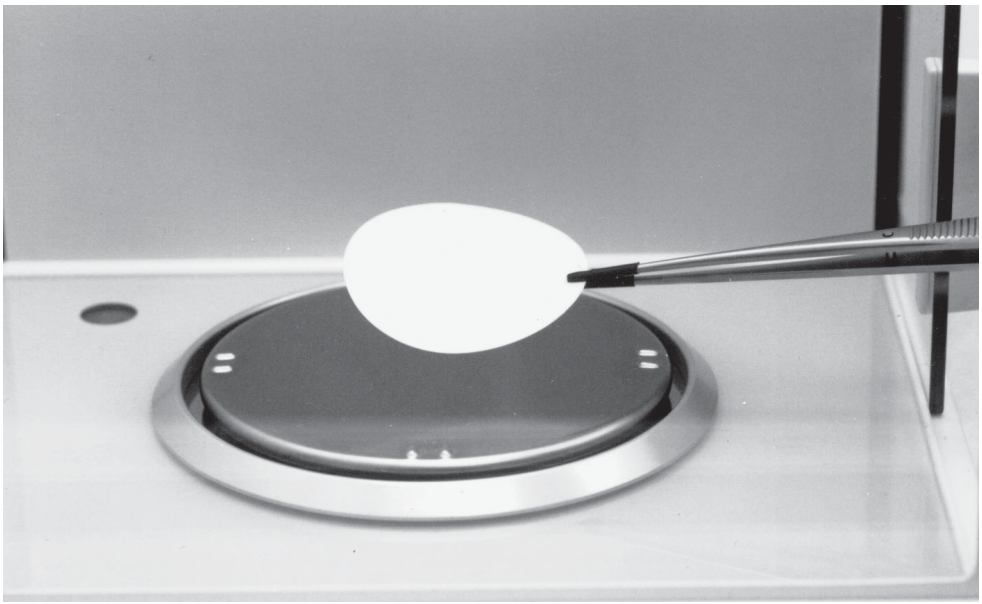
✔ The pre-sampling weighing must take place within 30 days of the sampling period.

1) Ensure that each filter has been equilibrated for at least 24 hours before weighing.

2) Filters must be weighed on a microbalance with a resolution of at least 1 µg (0.001 mg). Ensure that the balance has been allowed to warm up before performing any weighings.

3) Weigh each filter at least once (three times recommended), recording the mass in grams (Figure 3-1). The average mass reading is the initial filter weight, W_i. Use appropriate techniques to neutralize static charges on the filter. This pre-sampling weighing must take place within 30 days of the sampling period, as specified in 2.12 Quality Assurance Handbook, Section 7.

Figure 3-1. Positioning a 47 mm filter on a balance.



4) Immediately place each weighed filter into an open filter cassette (R&P part number 59-004648, Figure 3-2) and then close the filter cassette by snapping its top part onto the bottom section. Ensure that the top and bottom pieces of the cassette are pushed together completely.

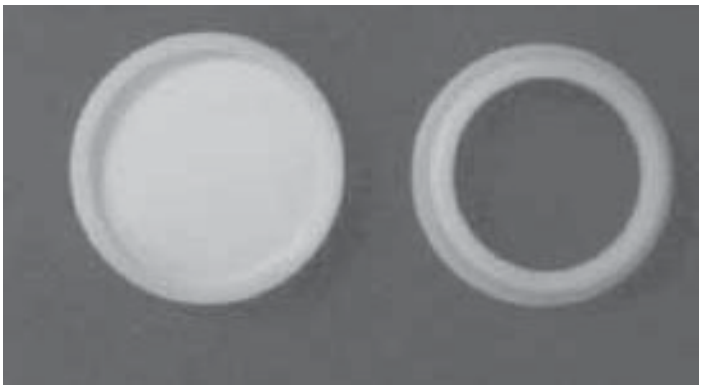


Figure 3-2. 47 mm filter placed in the bottom section of a filter cassette. The top part of the cassette is shown on the right-hand side.

5) Place the filter cassette with its 47 mm filter installed into the filter cassette carrier (55-004847), and place the entire assembly into the metal transport container (Figure 3-3) as specified in 2.12 Quality Assurance Handbook, Section 7. The container should be identified appropriately using a sticker or other system, and should contain a foam liner to ensure a snug fit.

Figure 3-3. Filter cassette carrier in transport container.

✔ Transport the filter to and from the sampling site using an R&P-supplied transport container.

6) Document the relative humidity, temperature, date and time of the initial weighing.

7) The “zero” reading of the microbalance should be verified between each filter weighing.

3.4. Filter Exchange

Collection filters must be transported carefully in their metal transport containers to and from the sampling site, as specified in 2.12 Quality Assurance Handbook, Section 8.

Follow these steps to exchange each filter cassette:

✘ Do not exchange sample filters until their sampling program is complete.

✔ The sampler must be in its Stop Operating Mode when removing the currently-installed filter.

1) Determine from the Main screen (Section 4.3) whether the unit is still sampling, i.e., whether it is in the Sampling Operating Mode (SAMP in the upper right-hand corner of the screen, Section 5.3). The Main screen displays the current time/date, as well as the programmed starting and ending time/date. If the device is still in its Sampling Operating Mode, allow it to complete its current sampling program before executing the steps below.

2) If the device is in the Stop or Error Operating Mode, press <F4: Run/Stp> in the Main screen to return the sampler to the Stop Operating Mode (Section 5.3). This causes the sampler to write the final information to the current record of filter data, and must take place before removing a currently-installed filter.

3) Pull the handle of the filter exchange mechanism toward the front of the instrument to lower the filter platform and expose the filter cassette in its carrier (Figures 3-4 and 3-5).

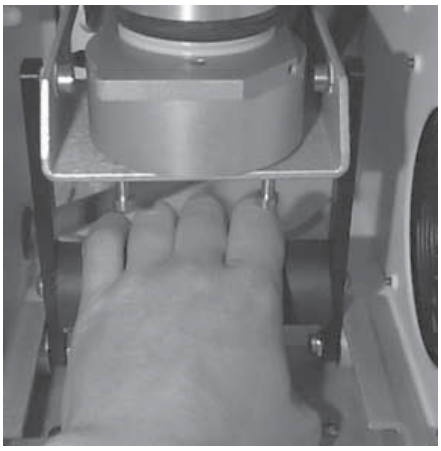


Figure 3-4 (Left). Gripping handle of filter exchange mechanism to prepare for filter exchange.

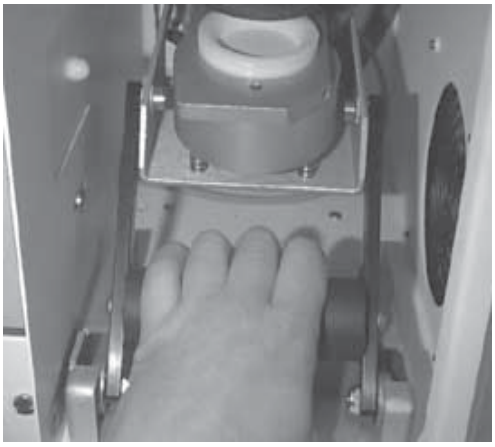


Figure 3-5 (Right). Pulling back on handle of filter exchange mechanism to disengage and lower the filter platform.

4) If a filter currently resides in the sampler, remove the filter cassette carrier with its installed filter cassette and 47 mm filter, and place this assembly into the filter transport container (Figure 3-6 and 3-3). Close the filter transport container and keep it sealed until the assembly arrives at the laboratory.

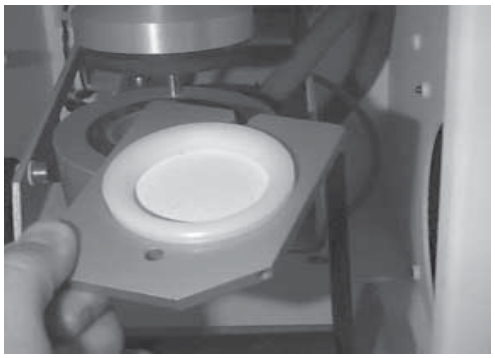
NOTE: The filter must be removed from the sampler within 96 hours of the end of sample collection according to the current U.S. EPA guidelines as found in 2.12 Quality Assurance Handbook, Section 7.

5) Perform any required maintenance of the system's WINS PM-2.5 Impactor, if necessary (Section 10.1 and Appendix H.2).

6) Remove the filter carrier containing the next 47 mm filter to be exposed from its transport container (Figure 3-3).

7) Carefully insert the filter cassette carrier with its installed filter cassette and new 47 mm filter into the lower part of filter exchange mechanism (Figure 3-6). The carrier contains a slot and hole that fit into the appropriate locations of the lower part of the filter exchange mechanism.

Figure 3-6. Inserting/ removing filter cassette in filter cassette carrier.



8) Push the handle of the filter exchange mechanism toward the back of the instrument to raise the filter platform and enclose the filter cassette (Figures 3-4 and 3-5).

✔ Perform any required maintenance on the WINS PM-2.5 impactor before installing the next sample filter.

9) Press <F1: FiltSet> in the Main screen to enter the Filter Setup screen (Section 5.2). Change the parameters shown in this screen to define the sampling program of the newly-installed filter.

10) Return to the Main screen (Section 4.3) by pressing <ESC> one or more times.

11) Press <F4: Run/Stp> to leave the Stop Operating Mode and enter either the Wait or Sampling Operating Mode (Section 5.3). The unit will automatically execute the sampling program defined in the Filter Setup screen of step 9 above.

12) If an exposed filter was removed from the sampler in step 4 above, press <F3: Data> in the Main screen to view the data for the removed filter in the Filter Data screen (Section 8.1). Press <F2: ->, if necessary, to view the appropriate record of filter data.

13) Record the information required for data computation and quality assurance purposes. At a minimum, this would usually include the volume sampled (Vol), the flow rate coefficient of variation (%CV), the total sampling time (Tot), the largest difference between the ambient and filter temperatures (TempDiff), and the status code (Stat).

14) When in the Filter Data screen, press <F4: PwrDat> to view power outage and filter ID information in the Power Outages screen (Section 8.1), or press <F5: IntvDat> to gain access to 5-minute averaged temperature and pressure data in the Interval Data screen (Section 8.2).

NOTE: The information contained in the Filter Data screen, Power Outages screen and Interval Data screen may be downloaded electronically into a laptop personal computer (PC) using software and a cable provided with the Partisol-FRM Sampler (Section 8.3).

3.5. Post-Collection Equilibration

Follow these steps to equilibrate 47 mm filters after sampling:

1) **Carefully remove the 47 mm filter from the filter cassette and place the filter in its petri dish. The cassette can then be used to hold other filters once it has been cleaned.**
2) **Examine the filter for defects that may have occurred during sampling, as well as for evidence of leaks in the filter cassette. Leaks manifest themselves as pronounced radial streaks that extend beyond the exposed area of the filter.**
3) **Place the petri dish cover *under* the bottom half of the dish.**
4) **Place a paper towel over the open petri dish during equilibration.**
5) **Record the filter number, relative humidity, temperature, date and time at the beginning of this post-collection equilibration.**
6) **Equilibrate each filter for *at least* 24 hours under the following conditions, as specified in 2.12 Quality Assurance Handbook, Section 7:**

   The equilibration room must be held at a constant relative humidity between 30 and 40% with a variability of not more than ±5% relative humidity.

   The equilibration room must be held at a constant temperature between 20 and 23 °C with a variability of not more than ±2 °C.

3.6. Post-Collection Weighing

Follow these steps to weigh the 47 mm collection filters after sampling:

1) Ensure that the filter has been equilibrated for at least 24 hours before weighing (Section 3.5).

2) Filters must be weighed on a microbalance with a resolution of at least 1 µg (0.001 mg). Ensure that the balance has been allowed to warm up before performing any weighings.

NOTE: U.S. EPA regulations require that the post-collection weighing be performed immediately following post-collection conditioning and within 10 days of sampling, and that it be performed by the same person and on the same balance as the initial filter weighing as found in 2.12 Quality Assurance Handbook, Section 7 and Section 11.

✔ Record the final filter weight as W_f.

3) Remove the filter from its petri dish.

4) Weigh each filter at least once (three times recommended), recording the mass in grams (Figure 3-7). The average mass reading is the final filter weight, W_f.

✔ The change in filter weight involves the W_i and W_f weights computed above.

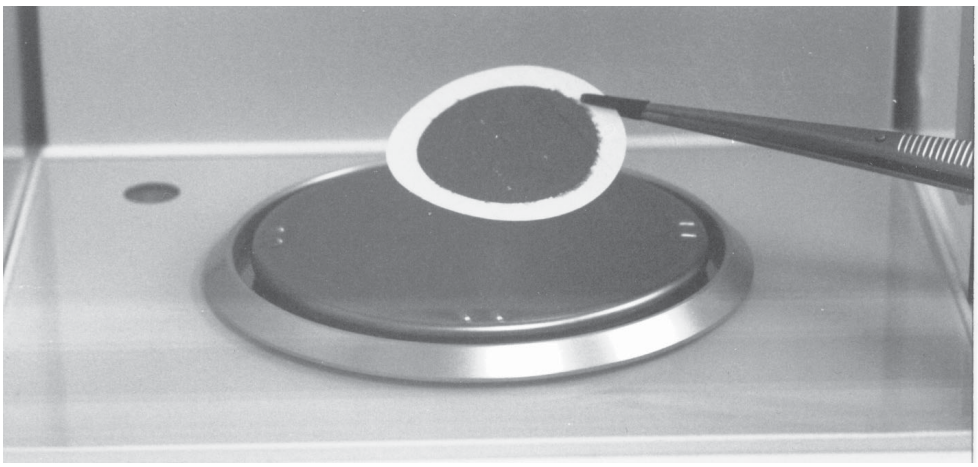


Figure 3-7. Placing a used 47 mm filter on a balance.

5) Return the filter to its petri dish, place the petri dish cover over it, and store it for archival purposes.

6) Document the relative humidity, temperature, date and time of the post-collection weighing.

7) The "zero" reading of the microbalance should be verified between each filter weighing.

8) Determine the net mass filter loading (DW) by subtracting the average initial filter weight (W_i (g) computed in step 3 of Section 3.3) from the final filter weight (W_f (g) computed in step 4 above). Ensure that the figures used in this computation were obtained from the *same filter and balance*.

3.7. Computation of Mass Concentration

Compute the average mass concentration (MC) of PM-2.5 during the sampling period using the following formula with the information assembled above, refer to 2.12 Quality Assurance Handbook, Section 11:

$$MC = \frac{\Delta W \times 10^6}{V}$$

where:

DW = the net change in the mass (g) of the 47 mm filter between the initial weighing and the post collection weighing, as computed in step 8 of Section 3.6 above.

10^6 = Conversion factor from grams (g) to micrograms (μg).

V = the volume (volumetric m^3) drawn through the filter, as recorded in step 12 of Section 3.4 above.

For 24-hour PM-2.5 concentration averages to be valid without adjustment for U.S. EPA reporting purposes, the total sampling time (Tot in step 12 of Section 3.4) must be between 23 and 25 hours, and other requirements must also be met as referenced in 2.12 Quality Assurance Handbook, Section 8. The value of the Stat field recorded in step 12 of Section 3.4 indicates whether the sampler encountered any adverse operational conditions (Section 7.1).

Section 4: Software Overview

This section describes the steps involved in turning on the Partisol-FRM Sampler, navigating through its basic screens, and in interacting with the device as a user. The software's menu structure and a complete listing of screens may be found in Appendix A.

Implementation of the subject matter covered in this section should only be attempted once the sampler is set up in accordance with Sections 2 and 3.

4.1. Turning On the Partisol-FRM Sampler

✔ Ensure that all applicable safety standards are met before applying power to the hardware.

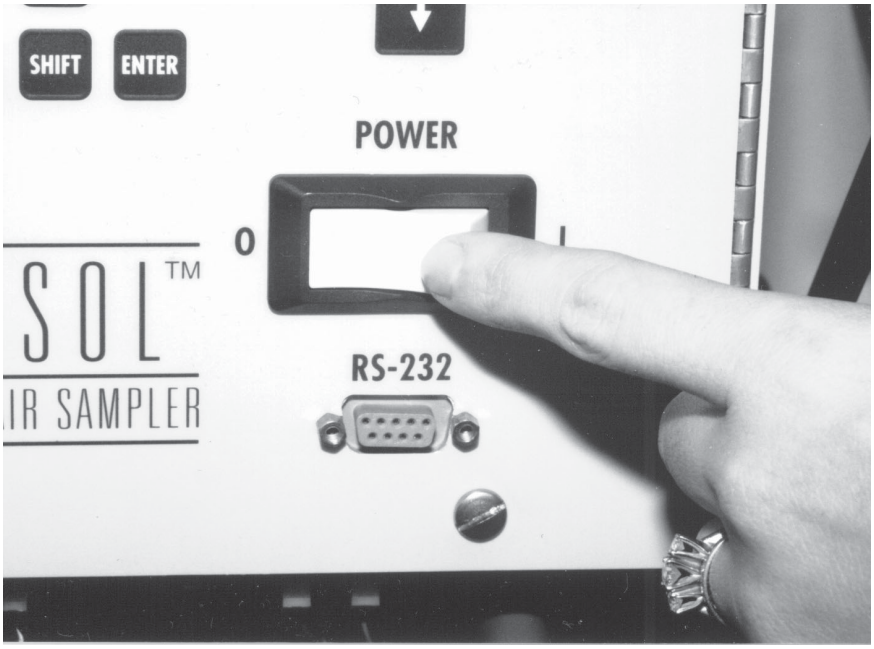
Follow the procedures outlined in Sections 2 and 3 carefully before attempting operation of the Model 2000 sampler. Once the sampling system has been wired to a main electrical source of the proper voltage in accordance with local standards, power can be applied to the unit.

> **WARNING:** Use of the suppled 120 VAC three-prong plug out of doors or in an uncontrolled interior environment may present a severe electrical shock hazard

Follow these steps to turn on the sampler:

1) Press the power switch on the main panel to its "on" (1) position to activate the sampler (Figure 4-1).

Figure 4-1. Pressing the on/off button into the "ON" position.



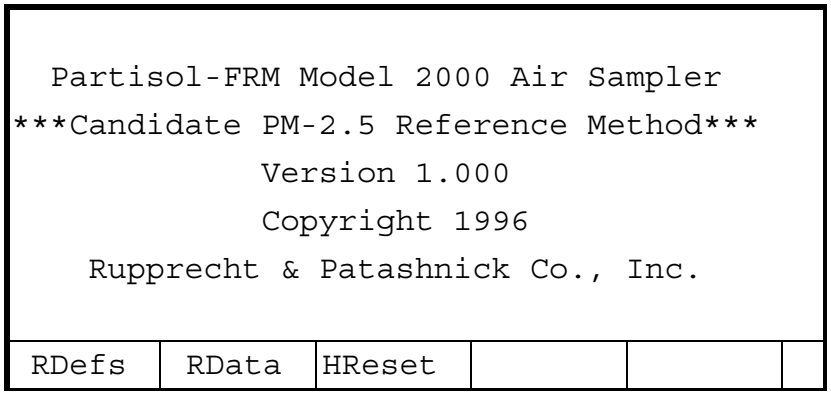
2) If necessary, turn the adjustment knob on the lower left-hand corner of the keypad to adjust the contrast of the liquid crystal display (LCD).

Once the power switch is pressed, the pump in the hub unit may start up momentarily. This is the default setting of the unit in case it is being turned on under extreme cold conditions where additional heat is necessary to warm the electronics.

4.2. TITLE SCREEN

The Title screen appears on the display of the sampler momentarily to identify the model number of the hardware and the revision number of the installed software (Figure 4-2). During the time that the sampler displays this screen, the user has a chance to reset the hardware by pressing the appropriate keys on the keypad (Section 12).

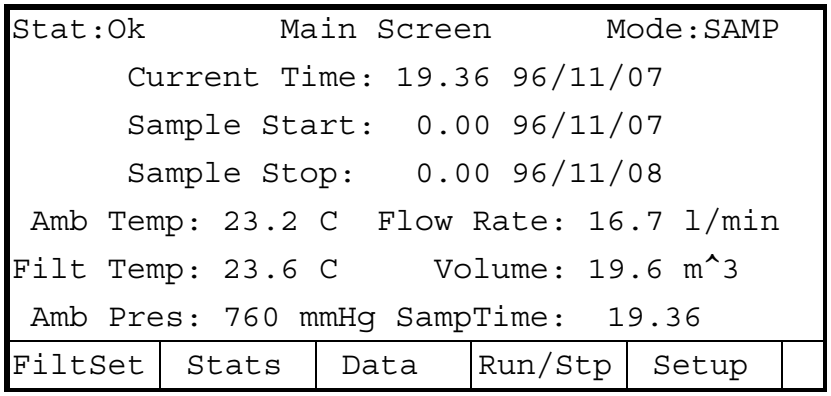
Figure 4-2. Title screen.



4.3. MAIN SCREEN

After a few seconds, the Title screen is automatically replaced by the Main screen (Figure 4-3). This screen shows summary information regarding the sampling program currently defined by the user, the current operating mode, the existence of any status conditions, as well as certain operational information.

Figure 4-3. Main screen.



The Main screen contains the following information:

Status Code — The value of the status code in the upper left-hand corner of the Main screen indicates whether or not the hardware is operating properly (Section 7.1). A value of "Ok" indicates that all functions are proceeding normally.

Operating Mode — The sampler displays the current operating mode in the upper right-hand corner of the Main screen. Press <F4: Run/Stp> to switch among the Stop, Wait, Sampling, and Done Operating Modes (Section 5.3).

Current Time — The local time and date are displayed on the second line of the Main screen. These variables should be set to their proper values in the Setup screen (Section 5.1) before commencing operation of the sampler. The Partisol-FRM Sampler expresses time as "hh.mm" and dates as "yy/mm/dd" in accordance with U.S. EPA requirements.

Sample Start	The Sample Start line indicates the time and date at which the sampler is currently programmed to begin sample collection. Press <F1: FiltSet> from the Main screen to enter the Filter Setup screen (Section 5.2). With the device in the Stop Operating Mode (Section 5.3), the user can change the sampling program from this screen.
Sample Stop	The Sample Stop line indicates the time and date at which the sampler is currently programmed to stop sample collection. Press <F1: FiltSet> from the Main screen to enter the Filter Setup screen (Section 5.2). With the device in the Stop Operating Mode (Section 5.3), the user can change the sampling program from this screen.
Amb Temp	This field contains the current ambient temperature (°C), as measured by the temperature probe mounted on the down tube.
Filt Temp	This field contains the current filter temperature (°C), as measured by a temperature sensor located within 1 cm of the sample filter's center.
Amb Pres	This field contains the current ambient pressure (absolute mm Hg), as measured by a pressure sensor located within the instrument enclosure.
Flow Rate	This field contains the current sample flow rate (volumetric l/min). The value of this field is "0" if the sample flow is currently turned off.
Volume	This field contains the total volume sampled (volumetric m^3). This field is reset to 0 whenever the user advances from the Done to the Stop Operating Mode (Section 5.3) by pressing <F4: Run/Stp>. The user may view stored data by entering <F3: Data> from the Main Screen (Section 8.1).
Sampling Time	This field contains the total elapsed sampling time (hh.mm). This field is reset to "0" whenever the user advances from the Done to the Stop Operating Mode (Section 5.3) by pressing <F4: Run/Stp>. The user may view stored data by entering <F3: Data> from the Main Screen (Section 8.1).

The function keys labelled “F1” to “F5” activate the commands shown on the bottom line of virtually every screen in the system. The following parts of this section describe how to navigate among the screens of the system software, as well as how to switch between the “Browse Mode” and “Edit Mode” to change the value of system parameters.

4.4. Navigating Among Screens

The system software allows the user to navigate easily through the use of soft function keys (<F1> to <F5>) and the <ESC> key (Figure 4-4). The depth of the sampler's menu structure is shallow, making it relatively easy to switch from one display to another (Figure 4-5). From the Main screen, simply press the soft key labelled <F1: FiltSet>, <F2: Stats>, <F3: Data> or <F5: Setup> to drop down one level in the screen structure. Pressing the <ESC> key causes the current display to be replaced by the next higher screen in the hierarchy. For example, pressing <ESC> when in the Filter Setup screen returns the user to the Main screen. The definition of the soft function keys changes as different screens appear on the display and different functions are required. Appendix A contains an overview of all screens included in the Partisol-FRM software.

✔ Use function keys to drop down by one layer in the structure of screens. Pressing <ESC> returns the user to the next highest level.

Figure 4-4. Keypad.

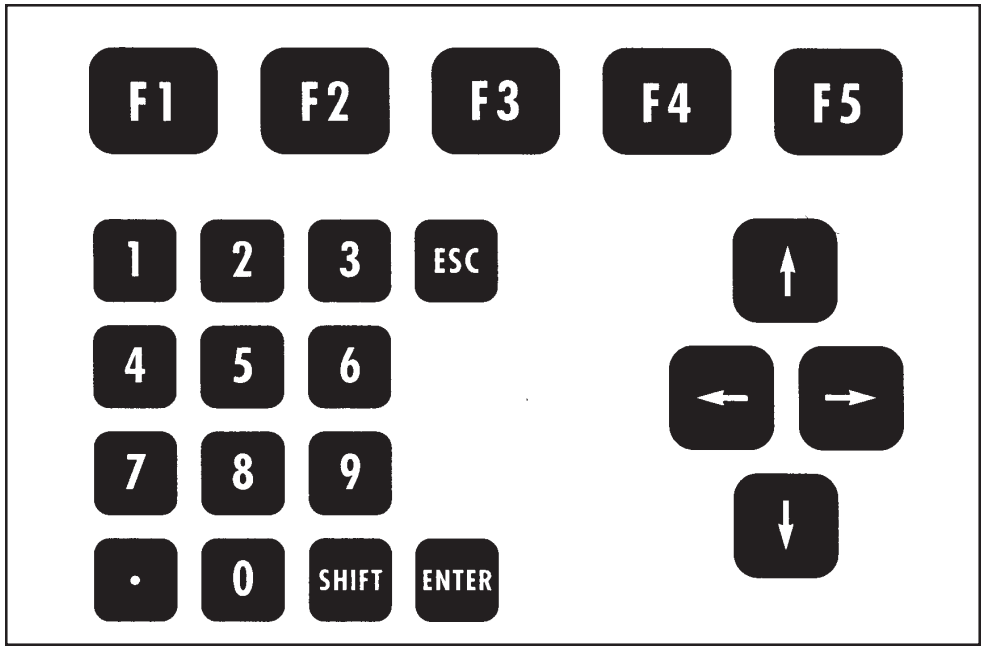
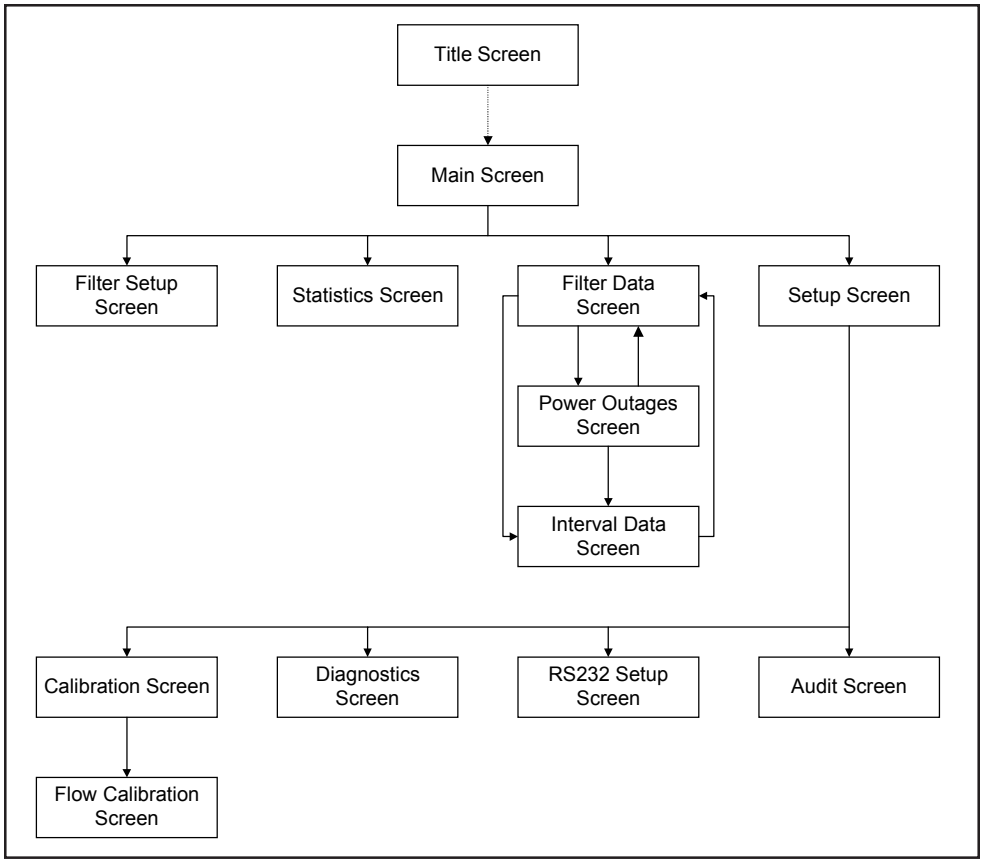


Figure 4-5. Hierarchy of instrument software screens.



The <F1: Edit> key is common to many screens. The function of this command, which causes the sampler to leave the Browse Mode and enter the Edit Mode, is described in the following parts of this section.

The <SHIFT> key plays a special role in accessing soft function keys. Certain displays, such as the Setup screen (Figure 4-6), have a ">" or "<" indicator on the right-most position of the bottom line. The appearance of these symbols indicates that the soft key menu for the current screen is two lines long, and that <SHIFT> can be pressed to toggle between the lines of the menu. This is the case both in the Browse Mode and the Edit Mode.

Figure 4-6. Setup screen.

Stat:Ok Setup Mode:SAMP					
Cur Time: 19.36.37 Def Start: 0.00					
Cur Date: 96/11/07 Def Dur: 24.00					
Set Flow: 16.7 l/min Std Temp: 99.9					
Std Press: 99.9					
FTS Const M: 0.0000 Soft Ver: 1.202					
FTS Const B: 0.0000 Ser Num: 1001					
Edit	Calib	Diag	RS232	Audit	>
Function Keys in Browse Mode					
Edit	Calib	Diag	RS232	Audit	>
Passwd					<
Function Keys in Edit Mode					
- -	-	+	++	Bksp	>
+/-					<

The following describes the use of the <SHIFT> key to switch between soft key menu lines:

✔ Press the <SHIFT> key to toggle between the two lines of the soft key menu, as indicated by ">" and "<."

> The first line of the soft key menu is currently being displayed. Press <SHIFT> to toggle to the second line of the soft key menu. Once this occurs, the "<" symbol appears in its place. This procedure applies when in the Browse Mode *and* Edit Mode.

< The second line of the soft key menu is currently being displayed. Press <SHIFT> to toggle to the first line of the soft key menu. Once this occurs, the ">" symbol appears in its place. This procedure applies when in the Browse Mode *and* Edit Mode.

For the descriptive purposes of this manual, the soft keys on the second line of the soft key menu are identified as "F6" to "F10."

4.5. EDIT MODE

The Partisol Sampler normally operates in the Browse Mode, which enables the user to navigate among all of its screens, but does not allow any changes to be made to system parameters.

To enter the Edit Mode, press the <F1: Edit> key. Because many screens contain information, such as flow rate set points that can only be changed when the sampler is in the Stop Operating Mode, the hardware beeps if it cannot enter the Edit Mode. In such a case, the user must return to the Main screen and press <F4: Run/Stp> before attempting to enter the Edit Mode in the desired screen.

The cursor changes from an *underline* when it is in the Browse Mode to a *large square* shape when the sampler is in the Edit Mode.

Many screens, such as the Setup screen (Figure 4-6), contain soft keys to decrement by larger or smaller amounts (<--> and <->, respectively) and to increment by larger or smaller amounts (<++> and <+>, respectively).

Numeric values can also be entered directly from the keypad. The <Bksp> (back-space) key erases previously typed characters.

Times expressed as “hh.mm” (or “hh.mm.ss”) are edited as two (or three) separate sections, and can be edited using the <-->, <->, <+> or <++> keys, or through direct keypad entry. Use the arrow keys on the keypad to move from one part of the time field to another.

✔ Use the arrow keys to move from one field to another while remaining in the Edit Mode.

Dates expressed as “yy/mm/dd” are edited as three separate sections, and can be changed using the <-->, <->, <+> or <++> keys, or through direct keypad entry. Use the arrow keys on the keypad to move from one part of the date field to another.

To edit multiple parameters while remaining in the Edit Mode, press the arrow keys on the keypad after making each change. This moves the cursor to a new field and keeps the Model 2000 unit in its Edit Mode. This does away with the need to toggle between the Browse Mode and Edit Mode for each parameter edited.

The following two keystrokes cause the software to leave the Edit Mode and return to the Browse Mode:

✔ Leave the Edit Mode by pressing <ENTER> to save changes or <ESC> to disregard changes.

<ENTER>	Changes made while in the Edit Mode are retained, and the sampler then returns to the Browse Mode.

<ESC>	Changes made while in the Edit Mode are *not* retained, and the sampler then returns to the Browse Mode.

The cursor reverts to its *underline* shape when the software returns to the Browse Mode.

The Filter Setup screen (Figure 4-7) makes special function keys available when the user is in the Edit Mode. The <F8: <-- > and <F9: --> > keys move the editing cursor to the left and right, respectively, when making changes to the ID1 and ID2 parameters. New numbers entered by the user overwrite any character that already resides in the current cursor position.

Figure 4-7. Filter Setup screen.

Stat:Ok Filter Setup Mode:SAMP					
Current Time: 19.36 96/11/07					
Start Time: 0.00 End Time: 0.00					
Start Date: 96/11/07 End Date: 96/11/08					
Set Flow: 16.7 l/min					
ID1: "96 "					
ID2: "00154 "					
Edit	Next Hr	NextDay	+ Day	Set Def	
Function Keys in Browse Mode					
Edit	Next Hr	NextDay	+ Day	Set Def	
Function Keys in Edit Mode					
--	-	+	++	Bksp	>
		<--	-->	Bksp	<

Section 5: Software Setup and Operation

This section describes the basic setup and operation of the Partisol-FRM Sampler. Do not attempt the procedures described in this section until carrying out the steps in Sections 2, 3 and 4. Appendix A displays all of the sampler's screens, while Appendix B contains a listing of the hardware's most important Program Register Codes.

5.1. Setup Screen

The Setup screen (Figure 5-1) allows the user to define global parameters for the operation of the Partisol-FRM Sampler, such as the current time and date, default flow rate, and default sampling time parameters. The user must make the desired entries for the current time, current date and default flow rate in the Stop Operating Mode in the manner described in Section 5.3.

Figure 5-1. Setup screen.

Stat:Ok		Setup		Mode:SAMP	
Cur Time: 19.36.37			Def Start: 0.00		
Cur Date: 96/11/07			Def Dur: 24.00		
Set Flow: 16.7 l/min			Std Temp: 99.9		
			Std Press: 99.9		
FTS Const M: 0.0000			Soft Ver: 1.202		
FTS Const B: 0.0000			Ser Num: 1001		
Edit	Calib	Diag	RS232	Audit	>
Function Keys in Browse Mode					
Edit	Calib	Diag	RS232	Audit	>
Passwd					<
Function Keys in Edit Mode					
- -	-	+	++	Bksp	>
+/-					<

Press <F5: Setup> when in the Main screen (Figure 4-3) to enter the Setup screen. All of the fields in the Setup screen with the exception of the software version number are editable when the instrument is in the Stop Operating Mode.

The following fields make up the Setup screen:

✔ The sampler only allows changes to these parameters if it is in the Stop Operating Mode (Section 5.3).

Cur Time The Cur Time parameter is the current local time (or other standard time selected by the user) expressed as hh.mm.ss. When editing this parameter, treat each part of the time as a separate field.

Cur Date The Cur Date parameter is the current local date expressed as yy/mm/dd. When editing this parameter, treat each part of the date as a separate field.

Set Flow The Set Flow parameter defines the flow rate (volumetric l/min) at which the device draws a sample when it is in the Sampling Operating Mode (Section 5.3). This is identical to the Set Flow field in the Filter Setup Screen (Section 5.2).

✔ The DefStart and DefDur parameters simplify the definition of sampling programs in the Filter Setup Screen (Section 5.2).

Def Start The Def Start parameter sets the default start time (hh.mm) of samples collected by the unit. The sampler uses this parameter to simplify sample programming in the Filter Setup screen (Section 5.2). The default value of 0 causes sampling to begin at midnight by default.

Def Dur The Def Dur parameter establishes the default sampling duration (hh.mm) of samples collected by the Partisol unit. The sampler uses this parameter to simplify sample programming in the Filter Setup Screen (Section 5.2). The default value of 24 causes the sampling duration to be 24 hours by default.

FTS Const m The FTS Constant parameter is the Streamline Flow Transfer Standard "m" calibration constant. The Streamline FTS can be used for verifying and calibrating the Partisol-FRM sampler flow. The sampler uses this constant to convert flow from inches H_2O into l/min.

FTS Const b The FTS Constant b parameter is the Streamline Flow Transfer Standard “b” calibration constant. The Streamline FTS can be used for verifying and calibrating the Partisol-FRM sampler flow. The sampler uses this constant to convert flow from inches H_2O into l/min.

Soft Ver	R&P increments the software version number when it issues new releases of the Partisol-FRM operating software. Refer to Appendix E for instructions to upgrade the system software. This field is not editable.
Ser Num	The Ser Num field contains a shortened version of the sampler's serial number or other identifying information.

✔ Password protection prevents inadvertent changes to system operations.

The Setup Screen enables users to turn on password protection by pressing <F6: Passwd> when in the Browse Mode. Refer to Section 5.7 for instructions to turn password protection on and off.

The Setup screen also provides users access to a variety of other hardware functions such as system calibrations (Section 1), diagnostics (Section 7), RS232 setup (Section 9), and audits (Section 10).

5.2. FILTER SETUP SCREEN

The Filter Setup screen (Figure 5-2) provides a straightforward way for users to define the sampling program to be executed by the sampler. Press <F1: FiltSet> when in the Main screen (Figure 4-3) to enter the Filter Setup screen. Ensure that the sampler is in the Stop Operating Mode (Section 5.3) before making any changes to the parameters contained in this screen.

Figure 5-2. Filter Setup screen.

```
Stat:Ok        Filter Setup      Mode:SAMP
      Current Time: 19.36 96/11/07
Start Time:  0.00      End Time:  0.00
Start Date: 96/11/07  End Date: 96/11/08
  Set Flow: 16.7 l/min
ID1: "96                                "
ID2: "00154                             "
```

Edit	Next Hr	NextDay	+ Day	Set Def	
Function Keys in Browse Mode					
Edit	Next Hr	NextDay	+ Day	Set Def	
Function Keys in Edit Mode					
--	-	+	++	Bksp	>
		<--	-->	Bksp	<

The Filter Setup screen contains the following fields to define the sampling program of the Partisol-FRM unit:

✔ The sampler automatically ensures that the ending time/date is greater than the beginning time/date. It beeps if it makes any adjustments to the user's inputs.

✔ Midnight is represented by time 0.

Start Time — The Start Time parameter defines the time of day (hh.mm) at which sampling is to begin. When editing this parameter, treat each part of the time as a separate field.

Start Date — The Start Date parameter sets forth the date (yy/mm/dd) on which sampling is to begin. When editing this parameter, treat each part of the date as a separate field.

End Time — The End Time parameter defines the time of day (hh.mm) at which sampling is to end. When editing this parameter, treat each part of the time as a separate field.

End Date — The End Date parameter sets forth the date (yy/mm/dd) on which sampling is to end. When editing this parameter, treat each part of the date as a separate field.

NOTE: To sample for an entire 24-hour period starting at midnight, enter 0 for both the Start Time and End Time parameters, and successive days for Start Date and End Date. For example, to sample during the entire day of 15 February 1997, enter 97/02/15 as the Start Date and 97/02/16 as for the End Date. Both the Start Time and End Time settings would be 0 in this case.

Set Flow — The Set Flow parameter determines the flow rate (volumetric l/min) at which the hardware samples when in the Sampling Mode (Section 5.3). This is identical to the Set Flow field of the Setup screen (Section 5.2).

ID1, ID2 — The Filter Setup screen contains two user-definable identification fields that are each 32 characters long. Use the special Edit Mode function keys <F8: <-- > (Shift F3:) and <F9: --> > (Shift F4::) to make changes to these fields. The sampler stores these fields in each record of filter data (Section 7.1).

A number of function keys in the Browse Mode simplify the process of defining the sampling program:

✔ The Browse Mode function keys of the Filter Setup screen simplify the programming of the sampler.

<F2: Next Hr> Pressing this key causes the sampler to revise the values of the Start Time, Start Date, End Time and End Date parameters. In this case, the start time and date are set so that the unit begins sampling at the start of the next whole hour. It automatically sets the ending time and date so that sampling takes place for the period defined by Def Dur in the Setup screen (Section 5.1).

<F3: NextDay> Pressing this key causes the sampler to revise the values of the Start Time, Start Date, End Time and End Date parameters. In this case, these parameters are automatically set so that the unit begins sampling at the time specified by Def Start and samples for the period defined by Def Dur in the Setup screen (Section 5.1). The unit uses the next available time slot that meets these requirements.

<F4: + Day> Pressing this key advances the values of Start Date and End Date by one day.

<F5: Set Def> Pressing this key causes the sampler to revise the Def Start and Def Dur parameters of the Setup screen (Section 5.1) in accordance with the starting time and sampling duration currently set in the Filter Setup screen.

NOTE: A convenient way to define the sampling program is to press <F3: Next Day> to define a base sampling period according to the Def Start and Def Dur parameters in the Setup Screen. Then press <F4: +Day> to increment the Start Date and End Date and arrive at the desired date.

5.3. Operational Modes

✔ Pressing <F4: Run/Stp> in the Main screen toggles the sampler between the Stop Operating Mode and the system's operational states.

The Partisol-FRM Sampler displays its current operating mode in the upper right-hand corner of the Main screen (Figure 4-3), as well as in the same position of certain other screens. Press <F4: Run/Stp> when in the Main screen to switch between the non-sampling Stop Operating Mode and the sampling program execution modes (Wait, Sampling, Done, Error).

The unit's operating modes (Figure 5-3) are defined as follows:

Stop Mode In the Stop Operating Mode (STOP), the user exchanges filter cassettes and defines the sampling program using the Filter Setup screen. As this is the only non-operational mode, all user-definable system parameters may be edited with the sampler in this state. Pressing <F4: Run/Stp> in the Main screen with the hardware in this mode causes the sampler to advance to the Wait or Sampling Operating Modes.

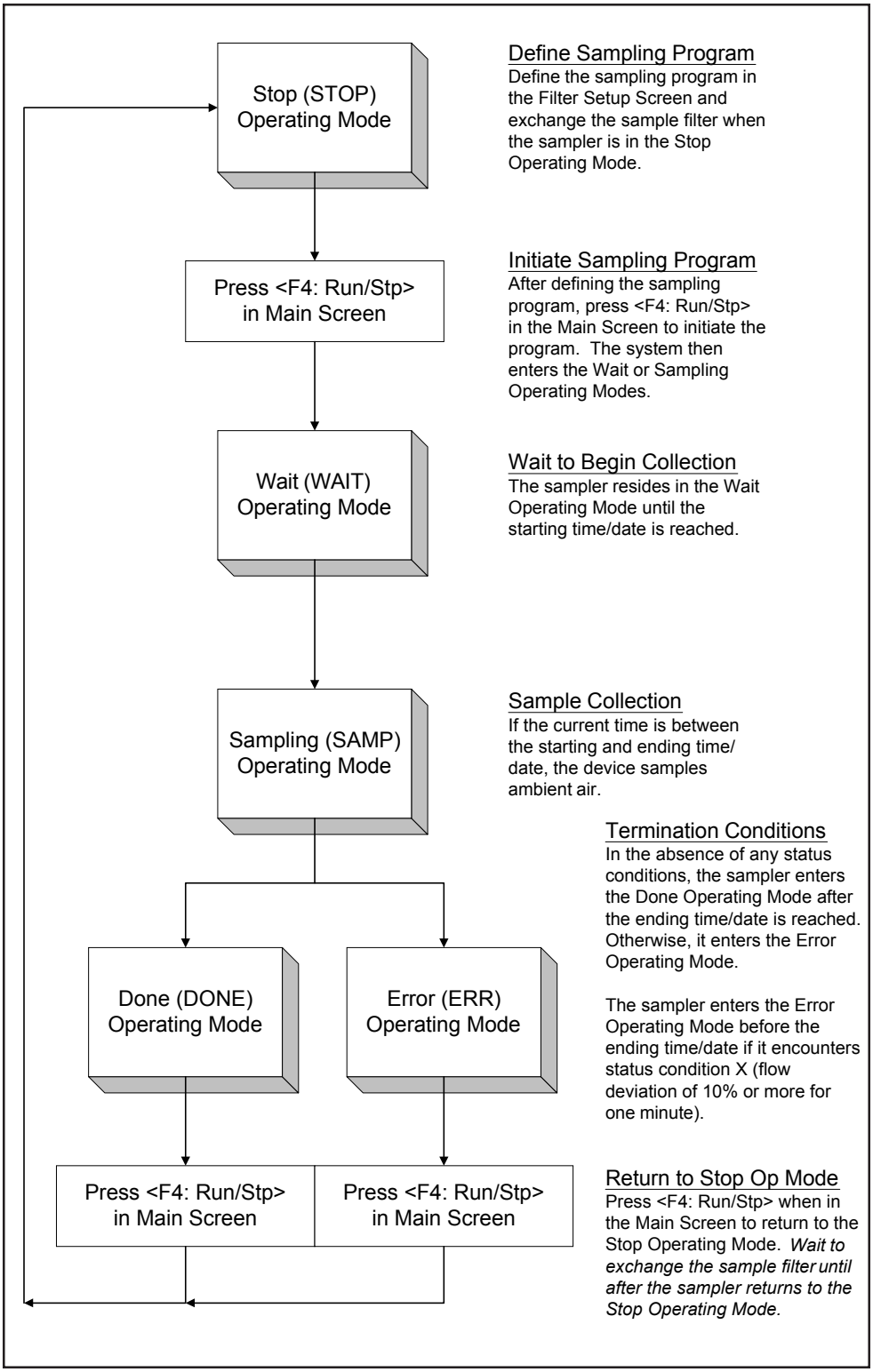
Wait Mode The Partisol system resides in this operating mode (WAIT) until the user-defined starting time/date is achieved. At that point, the device automatically enters the Sampling Operating Mode and begins sample collection. Pressing <F4: Run/Stp> in the Main screen with the hardware in this mode causes the sampler to return to the Stop Operating Mode.

Sampling Mode While in this operating mode (SAMP), the sampler draws ambient air through its sampling system at the volumetric flow rate specified by the user (16.7 l/min by default). Unless the sample flow rate deviates from its set point by 10% or more for more than 60 sec, sampling continues until the ending time/date is reached. Pressing <F4: Run/Stp> in the Main screen with the hardware in this mode causes the sampler to return to the Stop Operating Mode.

Once the ending time/date is reached, the unit automatically enters the Done Operating Mode if the current status code is "Ok," or enters the Error Operating Mode if the sampler has encountered a status condition (Section 6.1).

If the measured flow rate deviates from its set point by 10% or more for 60 sec, the sampler automatically enters

Figure 5-3. Overview of the sampler's operating modes.


Stop (STOP) Operating Mode
Press <F4: Run/Stp> in Main Screen
Wait (WAIT) Operating Mode
Sampling (SAMP) Operating Mode
Done (DONE) Operating Mode
Error (ERR) Operating Mode
Press <F4: Run/Stp> in Main Screen
Press <F4: Run/Stp> in Main Screen
Define Sampling Program
Define the sampling program in the Filter Setup Screen and exchange the sample filter when the sampler is in the Stop Operating Mode.
Initiate Sampling Program
After defining the sampling program, press <F4: Run/Stp> in the Main Screen to initiate the program. The system then enters the Wait or Sampling Operating Modes.
Wait to Begin Collection
The sampler resides in the Wait Operating Mode until the starting time/date is reached.
Sample Collection
If the current time is between the starting and ending time/ date, the device samples ambient air.
Termination Conditions
In the absence of any status conditions, the sampler enters the Done Operating Mode after the ending time/date is reached. Otherwise, it enters the Error Operating Mode.
The sampler enters the Error Operating Mode before the ending time/date if it encounters status condition X (flow deviation of 10% or more for one minute).
Return to Stop Op Mode
Press <F4: Run/Stp> when in the Main Screen to return to the Stop Operating Mode. Wait to exchange the sample filter until after the sampler returns to the Stop Operating Mode.

the Error Operating Mode even if the ending time/date is not yet achieved. In this case, the hardware displays a status code of "X" to indicate this condition (Section 6.1).

Done Mode — The sampler enters this mode (DONE) at the completion of its sampling program if it encountered no status conditions during sample collection (status code is "Ok"). Pressing <F4: Run/Stp> in the Main screen with the hardware in this mode causes the sampler to return to the Stop Operating Mode.

NOTE: *Do not exchange filter cassettes with the sampler in this mode.* Return to the Stop Operating Mode before exchanging the collection media.

Error Mode — The sampler proceeds to this mode (ERR) at the completion of its sampling program if it encountered a status condition during sample collection (status code is not "Ok"), or if it encounters the flow rate deviation condition, "X" (Section 6.1). Pressing <F4: Run/Stp> in the Main screen with the hardware in this mode causes the sampler to return to the Stop Operating Mode.

NOTE: *Do not exchange filter cassettes with the sampler in this mode.* Return to the Stop Operating Mode before exchanging the collection media

The sequence of steps required to operate the sampler are as follows:

- *Exchange the Filter and Define the Sampling Program*
  With the hardware in the Stop Operating Mode, define the sampling program in the Filter Setup screen (Section 5.2) and install a new filter cassette (Section 3).

- *Press <F4: Run/Stp> to Execute the Sampling Program*
  Press <F4: Run/Stp> in the Main screen to enter the Wait Operating Mode. The sampler automatically advances from this mode to the Sampling Operating Mode when it arrives at the starting time/date. Once sampling is complete, the hardware proceeds to the Done or Error Operating Mode, depending upon the existence of any status codes.

- *Press <F4: Run/Stp> to Return to the Stop Operating Mode*
  With the sampler in either the Done or Error Operating Mode, press <F4: Run/Stp> in the Main screen to return to the Stop Operating Mode. After

returning to this state, exchange the sample filter and define the sampling program for the next filter to be exposed.

The sampler completes the information recorded for each exposed filter in the filter storage buffer (Section 8.1) when the user returns the sampler to the Stop Operating Mode from one of its operational modes (Wait, Sampling, Done, and Error).

5.4. Turning off the Partisol-FRM Sampler

Follow these steps to turn off the hardware:

✔ Ensure that the sampler is in the Stop Operating Mode before turning off the power.

1) Display the Main screen by pressing <ESC> repeatedly, if necessary.

2) If the device is *not* in the Stop Operating Mode, press <F4: Run/Stp> to enter the Stop Operating Mode.

3) Press the power switch on the main panel of the Partisol-FRM Sampler into its "OFF" ("0") position (Figure 4-1).

5.5. Automatic Switching of Edit Modes and Screens

The Partisol-FRM Sampler takes a number of actions automatically during periods of inactivity:

- Anytime more than fifteen (15) minutes pass since the last keystroke was entered on the keypad, the backlighting of the LCD (liquid crystal display) dims. When this occurs, press any key to reactivate the screen's backlighting.

- If the sampler is left in the Edit Mode for more than five (5) minutes without any user keystrokes, it automatically reverts to the Browse Mode.

✔ The backlighting of the LCD is turned off when the sampler is left unattended for 15 minutes.

- Whenever the sampler remains in a screen other than the Main screen for longer than fifteen (15) minutes without any user keystrokes, the hardware automatically reverts to the Main screen.

5.6. Operation After Power Failure

The Partisol-FRM Sampler performs the following actions upon resumption of power if the power failure occurs while the sampler is in its Sampling Operating Mode:

- If the power outage is longer than 60 sec, the hardware registers a "V" status condition (Section 7.1) and stores the starting time of the power failure in "hh.mm" format in the current record of filter data (Section 8.1).

- If the ending time/date is not yet reached upon resumption of the power supply, the sampler continues its sampling program in the Sampling Operating Mode. Otherwise, it enters either the Done or Error Operating Modes, depending upon the existence of any status conditions.

✔ A large flow deviation spanning more than 60 seconds causes sampling to be cut off prematurely.

✔ Ensure that the sampler is in the Stop Operating Mode before turning off the power.

If the hardware is not in the Sampling Operating Mode at the time of the power failure, the unit resumes operation in its pre-outage operating mode upon restoration of power.

5.7. Password Protection

With password protection turned on, the sampler restricts the user to the Main screen, and does not allow entry into the Edit Mode.

5.7.1. Turning On Password Protection

Follow these steps to initiate the password protection feature:

1) Before initiating password protection, record the instrument's five-digit serial number ("Ser Num") in the Setup screen (Figure 5-1). This is required to turn password protection off.

NOTE: If the sampler's serial number is not five digits long, then enter a value in the Ser Num field that is five characters long prior to turning on password protection.

2) Press <F6: Passwd> to begin the password protection process.

3) Enter "YES" in the confirmation screen to turn password protection on.

Upon entering password protection, the unit jumps to the Main screen and does not allow for any keypad interaction except for turning off password protection.

5.7.2. Turning Off Password Protection

Follow these steps to turn off the password protection feature:

1) When in the Main screen with password protection enabled, enter the following keystrokes:

<ENTER> instrument serial number <ENTER>

NOTE: The instrument will beep after each keystroke.

2) The sampler will display a message indicating the successful deactivation of password protection. If this procedure was *not* successful, the unit will beep twice.

Refer to Section 12.4 for further information on deactivating password protection.

Section 6: Sampler Operation

This section describes the steps involved in verifying sampler performance characteristics prior to starting a sampling run, programming a sampling run and retreiving data after a sampling run.

6.1. Pre-Sampling Verification

R&P recommends that the user perform the pre-sampling verification tests every three months of routine operation and whenever the sampler is relocated. However, individual monitoring organizations may abide by different standards.

Follow these steps to perform the pre-sampling verification procedure:

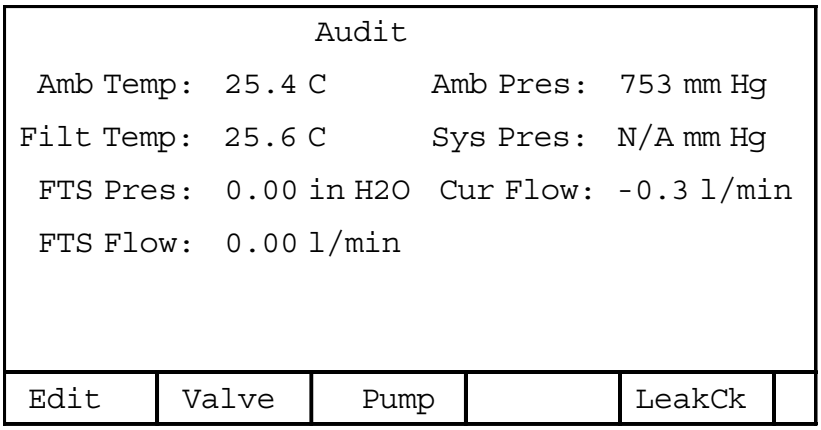
NOTE: Refer to Section 6 of the U.S. EPA 2.12 Quality Assurance Handbook for the U.S. EPA verification schedule requirements.

NOTE: Refer to Section 10 of this manual for more detailed information on programming the sampler for performance verification.

1) **Turn on the sampler by pressing the power switch on the main panel to its "ON" position. The sampler must be in the Stop Mode to perform the verification audits. If the sampler is not in the Stop Mode, press <F4: Run/Stop> when in the Main screen.**

2) **Verify the sampler's ambient temperature by pressing <F5: Setup> to access the Setup screen, then press<F5:Audit> to access the Audit screen (Figure 6-1). Determine the current ambient temperature (°C) at the ambient temperature sensor using an external thermometer. Verify that the value for the temperature displayed by the Partisol-FRM in the Audit screen is within ±2 °C of the measured temperature. If this is not the case, the sampler requires calibration (Service Manual).**

Figure 6-1. Audit screen.



3) Verify the sampler's filter temperature by measuring the temperature (°C) at the location of the filter in the Partisol-FRM Sampler using an external thermometer. Verify that the value for the temperature displayed by the sampler in the Audit screen is within ±2 °C of the measured temperature. If this is not the case, the sampler requires calibration (Service Manual).

4) Verify the sampler's ambient pressure by measuring the current ambient station pressure in mm Hg (i.e., absolute pressure, not corrected to sea level). Verify that the value for ambient pressure displayed in the Audit screen is within ±10 mm Hg of the measured ambient pressure. If this is not the case, the sampler requires calibration (Service Manual).

5) Install a clean, unused 47 mm filter into the filter cassette. Place the filter cassette with its 47 mm filter installed into the filter cassette carrier. Carefully insert the filter cassette carrier into the lower part of the filter exchange mechanism. The carrier contains a slot and hole that fit into the appropriate locations of the lower part of the filter exchange mechanism. Push forward on the handle of the filter exchange mechanism to raise the filter platform and enclose the filter cassette. Carefully remove the PM-10 inlet from the sampler and install the supplied flow audit adapter on the end of the sample tube (Figure 6-2). Turn the valve on the flow audit adapter to its closed position.

Figure 6-2. Flow audit adapter installed on the end of the sample tube.

6) If you have a unit that supports the automatic leak check function (Section 10), go to step 7. If you do not have a unit that supports the automatic leak check function, go to Section 10.

7) Perform a leak check by pressing <F5: LeakCk>. Follow the instructions on the screen to begin the automatic leak check cycle. (Turn off the manual shut off valve attached to the large air filter on the left-hand side of the manifold in the hub. This corresponds to location "A" in Figure 6.3. Wait for the automatic leak check cycle to complete. The sampler will display a message at the end of the cycle indicating the vacuum loss (mm Hg) during the 60 second leak check, and a pass or fail message. The criteria for a successful leak test is a drop of less than 127 mm Hg in one minute. Open the manual valve on the sampler then release the vacuum (slowly) by opening the flow audit adapter valve. If the leak check fails, refer to Section 10).

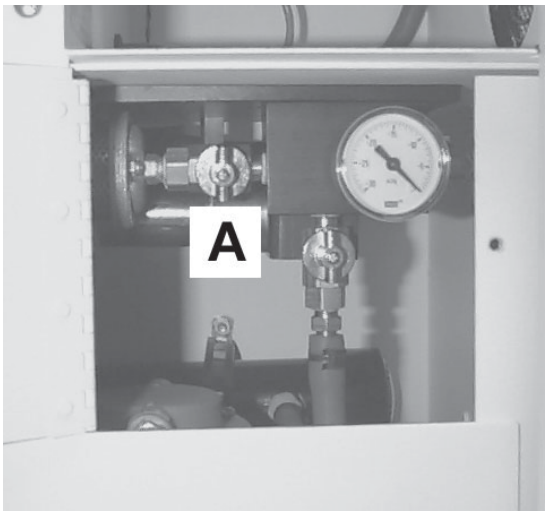


Figure 6-3. Flow control manual valve (A) displayed in its closed position.

8) Verify the sampler's flow. If you are using a Streamline Flow Transfer Standard (FTS) to measure flow, refer to Section 10 to program the sampler with the FTS calibration constants. Remove the flow audit adapter and attach the Streamline FTS to the sample tube (Figure 6-4). Other flow meters may require the use of the flow audit adapter (with its valve in the open position).

Figure 6-4. Streamline FTS installed on the end of the sample tube.

9) Press <F2: Pump>, then <F1: Valve>. If you are using the Streamline FTS, press <F1: Edit> then enter the pressure drop (inches H_2O), and then press the <ENTER> key. The Partisol-FRM will calculate the flow in l/min. If you are not using the Streamline FTS, determine the flow in actual (volumetric) l/min using the external flow meter.

10) Verify either that the displayed Streamline FTS Flow or the measured flow is within ±5% of the value displayed in the "Flow Rate" field of the Audit screen. If this is not the case, the sampler requires calibration (Service Manual).

11) The performance verification is now complete. Return to the Main screen by pressing the <ESC> key twice.

12) Restore the sampling hardware to its original state by removing the flow metering hardware and reinstalling the PM-10 inlet on the sample tube. Remove the filter cassette from the sampler and discard the installed filter.

6.2. PROGRAMMING SAMPLER SETUP

This section describes the procedures for programming the sampler for a sampling run. A filter cassette with a 47 mm filter must be installed in the hardware before starting the sampling run.

> NOTE: Refer to Section 5 of this manual for more detailed information on programming sampler setup.

Follow these steps to program the sampler for sampling:

1) **If the sampler is not in the Stop Mode, press the <RUN/STOP> key when in the Main screen to enter the Stop Mode.**
2) **Press <F5:Setup> to access the Setup screen.**
3) **Confirm that the correct time, date and set flow rate are displayed on the Setup screen. If the correct time, date and set flow rate are not displayed, re-set the sampler by pressing <F1: Edit>, then enter the correct data using the keypad. Press the <ENTER> key.**
4) **Press the <ESC> key to return to the Main screen, then <F1:Setup> to enter the Filter Setup screen (Figure 6-5).**

Figure 6-5 Filter Setup screen.

```
Stat:Ok        Filter Setup      Mode:SAMP
      Current Time: 19.36 96/11/07
Start Time:  0.00      End Time:  0.00
Start Date: 96/11/07  End Date: 96/11/08
  Set Flow: 16.7 l/min
ID1: "96                                "
ID2: "00154                             "
```

Edit	Next Hr	NextDay	+ Day	Set Def	
Function Keys in Browse Mode					
Edit	Next Hr	NextDay	+ Day	Set Def	
Function Keys in Edit Mode					
--	-	+	++	Bksp	>
		<--	-->	Bksp	<

5) **Press <F1:Edit>, then enter the sample run start time and start date, end time and end date, (and ID1 and ID2 if desired). Press the <ENTER> key. Press the <ESC> key to return to the Main screen.**

6) **Press the <RUN/STOP> key. The sampler should now enter the Wait Mode. Verify that the correct sampler run data (start time and date, etc.) is displayed on the Main screen.**

7) **When the clock time equals the sample start time, the sampler will automatically enter the Sampling Mode and begin the sampling run.**

8) **When the clock time equals the sample stop time, the sampler will automatically end the sampling run, and enter the Done Mode. If a status condition occurred during the sampling run, the Error Mode will display instead of the Done Mode.**

9) **Press <F4: Run/Stop> to enter the Stop Mode before exchanging filter cassettes or retrieving data on the sampling run.**

6.3. Post Sampling Verification and Data Retrieval

This section describes the procedures for verifying the sampling run status and retrieving the sampling run data.

> NOTE: Refer to Section 7 and 8 for more complete information on verification and data retrieval.

Follow these steps to verify the sampling run and retrieve data from the unit:

1) **After the sampling run is complete, press the <RUN/STOP> key when in the Main screen to enter the Stop Mode.**
2) **Remove the filter cassette in the carrier from the sampler by pulling on the handle of the filter exchange mechanism. Place the entire assembly in a metal transport container.**
3) **Check the sampling run status on the Main screen. Note any status code other than "OK."**
4) **Press <F3: Data> to view the filter data from the sampling run. Record data from the Filter Data screen (Figure 6-7) onto a sampling run log sheet, if desired.**

Figure 6-7. Filter Data screen.

Stat:Ok		Filter Data		Rec: 937	
Set: 0.00 96/11/05			Min	Ave	Max
Strt: 0.00 96/11/05		AmbT:	11.5	16.8	21.9
Stop: 0.00 96/11/06		FltT:	11.6	17.0	22.4
Tot: 24.00		Pres:	759	760	761
TempDiff: 0.8		AveFlow:	16.7	Vol:	24.0
14.07 96/11/05				%CV:	0.1
	-	+	PwrDat	IntvDat	>
Function Keys in Browse Mode					
	-	+	PwrDat	IntvDat	>
First			Last	Output	<

5) If there were any status codes other than "OK," verify the validity of the sampling run from the output of the Filter Data screen. Press <F4: PwrDat> to view the Power Outage Data screen. Press the <ESC> key to return to the Filter Data screen.

6) Download stored data from the sampling run onto a personal computer (PC). Connect the PC to the sampler with the 9 pin-to-9 pin RS232 connector cable.

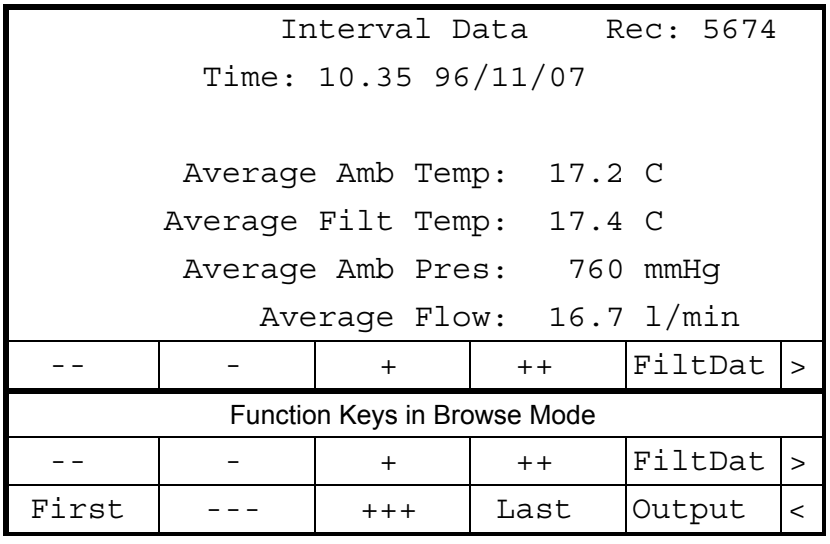
7) Use AKCOMM or any other data transfer program to transfer data from the sampler to the PC.

8) Ensure that the sampler is in the Browse Mode.

9) When in the Filter Data screen, use the function keys <F1> to <F8> to move to the first record of the sampling run. Press the <F5> function key to access the <F10: Output> function key. All data from the current record displayed in the screen to the last record will automatically download from the sampler to the PC.

10) Press <F5:IntvDat> to access the Interval Data screen (Figure 6-8). Use the function keys to move to the first record that you wish to download. Press the <F5> function key to access the <F10: Output> function key. All interval data from the current record displayed in the screen to the last record will automatically download from the sampler to the PC.

Figure 6-8. Interval Data Screen.


Interval Data Rec: 5674
Time: 10.35 96/11/07
Average Amb Temp: 17.2 C
Average Filt Temp: 17.4 C
Average Amb Pres: 760 mmHg
Average Flow: 16.7 l/min
-- - + ++ FiltDat >
Function Keys in Browse Mode
-- - + ++ FiltDat >
First --- +++ Last Output <

11) Save the transferred data to the PC.

12) Disconnect the RS232 cable.

13) Press the <ESC> key twice to return to the Main screen.

14) Perform any necessary scheduled maintenance.

15) Insert a new filter cassette assembly with a 47 mm filter into the filter exchange mechanism. Push the handle to raise the platform, and enclose the filter cassette in the sampling position.

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Section 7: On-Screen Operating Information

This section describes the status codes generated by the Partisol-FRM Sampler, as well as the operating information contained in the Statistics and Diagnostics screens.

7.1. Status Codes

The sampler displays operational status codes in the upper left-hand corner of the Main screen (Figure 4-3) next to "Stat," as well as on several other screens. The hardware resets the status to "Ok" (no current conditions) after the user presses <F4: Run/Stp> from the Main screen to return the unit to the Stop Operating Mode.

With the occurrence of any status conditions, the sampler displays the single-letter abbreviation for each flag that applies. The following list details the system's status codes and definitions:

✔ The sampler displays the current status code in the upper left-hand corner of the Main Screen and several other screens.

Ok — *No current status conditions.*

F — *Flow Rate.* The measured sample flow rate deviates by more than 5% from its set point for more than 30 seconds.

X — *Flow Cutoff.* The measured sample flow rate deviates by more than 10% from its set point for more than 60 sec.

S — *Ambient Temperature Sensor.* The ambient temperature sensor is not plugged in or is indicating an invalid value (less than -150 °C or greater than 60 °C).

P — *Ambient Pressure Sensor.* The ambient pressure sensor is not installed correctly or is indicating an invalid value (less than 300 mm Hg or greater than 900 mm Hg).

T — *Filter Temperature.* The measured filter temperature exceeds the measured ambient temperature by more than 5 °C for more than ten consecutive minutes during sampling or post-sampling periods of operation.

✔ A heater in the instrument electronics compartment ensures that the control zone stays within limits under cold temperature conditions.

I — *Instrument Electronics Temperature.* The temperature of the instrument electronics is outside of its usual operating range (less than -5 °C or greater than 60 °C).

V — *Power Outage (Voltage).* A power outage of greater than 60 seconds occurred during sample collection.

E *Elapsed Sample Time.* The elapsed time of the sample was less than 23 hours or greater than 25 hours.

C *Coefficient of Variation.* The coefficient of variation of the sample flow rate, expressed as a percentage, was greater than 4 (4%) during the sampling interval.

✔ The current status code is made up of one or more single-letter abbreviations or "Ok."

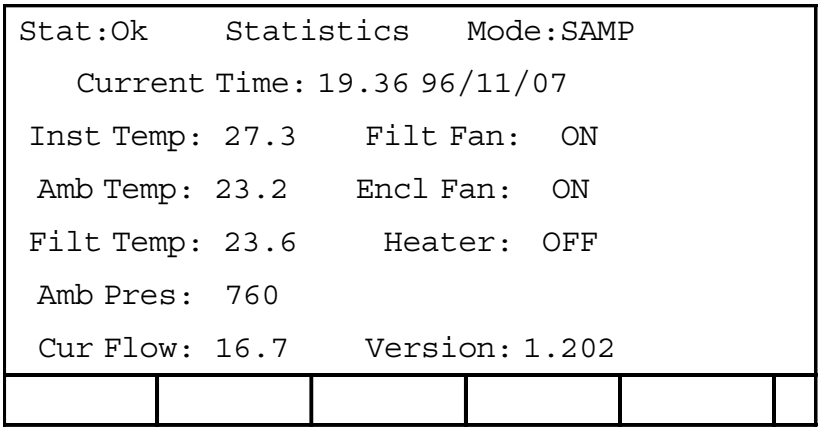
In the case of multiple status conditions, the sampler displays the single-letter abbreviation of all applicable flags in the status field of the Main screen and other screens with a status condition field. For example, the sampler would display "FV" in the case of simultaneous flow rate and power outage conditions.

The hardware stores all status conditions that apply to each exposed filter in the filter data storage buffer (Section 8.1).

7.2. STATISTICS SCREEN

The Statistics screen (Figure 7-1) displays more detailed operational information than is shown on the sampler's Main screen. Press <F2: Stats> when in the Main screen to display the Statistics screen. This screen does not contain any editable fields.

Figure 7-1. Statistics Screen.


Stat:Ok Statistics Mode:SAMP
Current Time: 19.36 96/11/07
Inst Temp: 27.3 Filt Fan: ON
Amb Temp: 23.2 Encl Fan: ON
Filt Temp: 23.6 Heater: OFF
Amb Pres: 760
Cur Flow: 16.7 Version: 1.202

The Statistics screen contains the following fields:

Stat	The current status code (Section 7.1).
Mode	The current operating mode (Section 5.3).
Current Time	The current time and date, as determined by the system's battery-backed clock. The user may reset the time/date in the Setup Screen (Section 5.1) in the Stop Operating Mode.
Inst Temp	The current temperature (°C) of the instrument electronics.
Amb Temp	The current ambient air temperature (°C).
Filt Temp	The current filter temperature (°C), as measured within 1 cm of the center of the sample filter.
Amb Pres	The current ambient pressure (absolute mm Hg).
Cur Flow	The current sample flow rate (volumetric l/min).

Filt Fan	The current operating status of the fan in the filter compartment (ON or OFF).
Encl Fan	The current operating status of the fan in the pump compartment (ON or OFF).
Heater	The current operating status of the heater in the electronics compartment (ON or OFF).
Version	The revision number of the system's operating software.

Press the <ESC> key to return to the Main screen from the Statistics screen.

7.3. DIAGNOSTICS SCREEN

The Diagnostics screen (Figure 7-2) displays more low-level operational information about the Partisol-FRM Sampler. When in the Main screen, press <F5: Setup> and then <F3: Diag> to display the Diagnostics screen. The Service Manual (42-004278) of the Partisol-FRM Sampler contains routines that make use of the Browse and Edit Mode function keys of the Diagnostics screen.

Figure 6-2. Diagnostics Screen.

Diagnostics					
Analog I/O		Digital I/O			
Pres: 4.062	FltT: 3.019	Val:ON	FnP:OFF		
InsT: 3.128	Aux1: 0.000	Aux:OFF	Pmp:ON		
AmbT: 3.016	Aux2: 0.000	Aux:OFF	Lcd:ON		
3: 2.644	Flow: 3.991	FnF:ON	Htr:OFF		
A/O1: 2.50	A/O2: 1.66	Rev: 1			
Edit	Off	On			
Function Keys in Browse Mode					
Edit	Off	On			
Function Keys in Edit Mode					
--	-	+	++	Bksp	

The Diagnostics screen contains the following fields:

Pres	The current analog input level (VDC) from the ambient pressure sensor.
InsT	The current analog input level (VDC) from the instrument electronics temperature sensor.
AmbT	The current analog input level (VDC) from the ambient temperature sensor.
3	Not used.

FltT	The current analog input level (VDC) from the filter temperature sensor.
Aux1, Aux2	Not used.
Flow	The current analog input level (VDC) from the mass flow sensor.
A/O1	The current analog output level (VDC) to the valve in the mass flow controller.
A/O2	The current analog output level (VDC) to the user analog output port on the back of the sampler (Section 8).
Val	The current position of the flow cutoff valve (ON or OFF).
Aux, Aux	Not used.
FnF	The current operating status of the fan in the filter compartment (ON or OFF).
FnP	The current operating status of the fan in the pump compartment (ON or OFF).
Pmp	The current operating status of the sample pump (ON or OFF).
Lcd	The current operating status of the LCD (liquid crystal display) backlighting (ON or OFF).
Htr	The current operating status of the heater in the instrument electronics compartment (ON or OFF).

When in the Diagnostics screen, press the <ESC> key twice to return to the Main screen.

Section 8: Viewing and Transmitting Stored Data

✔ The Partisol-FRM Sampler has a capacity of 25 filter data records and two weeks of interval data records. Data are stored in a circular buffer on a "first in, first out" basis.

The Partisol-FRM Sampler stores two types of data in its internal data logger: filter data and interval data. This information is stored in two separate circular buffers whose contents can be viewed on the screen of the sampler and/or downloaded through the RS232 port. Once these buffers are filled, the oldest data points are replaced with the most recent information ("first in, first out"). The following describes the two types of data stored internally in the hardware:

Filter Data	Each record in this buffer contains information for a different collection filter exposed to the sample stream. The sampler displays records from this buffer in the Filter Data screen (Figure 8-1) and Power Outages screen (Figure 8-2). The Power Outages screen shows detailed information for the current record of filter data that is not included in the Filter Data screen. The Partisol-FRM Sampler has a capacity of 25 records of filter data.
Interval Data	The sampler writes a new record of interval data every five minutes. Each record contains the latest five-minute average of the ambient temperature, filter temperature, and ambient pressure. The hardware displays records from this buffer in the Interval Data screen (Figure 8-3). The Partisol-FRM Sampler has a capacity of two weeks of interval data.

Press <F3: Data> when in the Main screen (Figure 4-3) to access the Filter Data screen (Figure 8-1). From this screen, enter <F4: PwrDat> to view additional data for the current record of interval data in the Power Outages screen (Figure 8-2). Press <F4: FiltDat> when in the Power Outages screen to return to the Filter Data screen.

Press <F5: IntvDat> when in the Filter Data screen to view the Interval Data screen (Figure 8-3), or press <F5: FiltDat> when in the Interval Data screen to return to the Filter Data screen. With the exception of the Power Outages screen, the sampler displays the last record of the respective database when the user enters the screens. There are no editable fields in any of these displays.

8.1. FILTER DATA

Data for each filter used in the Partisol-FRM Sampler are stored as a separate record of filter data. For readability, the sampler splits the display of filter data records between two screens: the Filter Data screen (Figure 8-1) and the Power Outages screen (Figure 8-2). Press <F4> to toggle between these two screens while remaining in the same filter data record.

Figure 8-1. Filter Data screen.

Stat:Ok		Filter Data		Rec: 937	
Set: 0.00 96/11/05			Min	Ave	Max
Strt: 0.00 96/11/05		AmbT:	11.5	16.8	21.9
Stop: 0.00 96/11/06		FltT:	11.6	17.0	22.4
Tot: 24.00		Pres:	759	760	761
TempDiff: 0.8		AveFlow:	16.7	Vol:	24.0
14.07 96/11/05				%CV:	0.1
	-	+	PwrDat	IntvDat	>
Function Keys in Browse Mode					
	-	+	PwrDat	IntvDat	>
First			Last	Output	<

The sampler displays the following filter data fields in the Filter Data screen:

✔ The hardware stores one record of filter data for each collection filter exposed.

Stat — The Stat field in the upper left-hand corner of the screen shows the status conditions encountered during and after the exposure of the sample filter. A value of "Ok" indicates that the sampler did not encounter any status conditions, and Section 7.1 contains a listing of the single-letter status codes that may be displayed in this field.

Rec — The number of the current record is displayed in the upper right-hand corner of the screen.

Set — The Set field displays the starting time/date (hh.mm yy/mm/dd) entered by the user.

Strt	The Strt field shows the actual starting time/date (hh.mm yy/mm/dd) at which the unit began sampling.
Stop	The Stop field indicates the actual ending time/date ((hh.mm yy/mm/dd) at which the system stopped sampling.
Tot	The sampler displays the elapsed sampling time (hh.mm) in the Tot field.
TempDiff	The fields to the right and below the "TempDiff" title show the maximum difference (°C) between the filter and ambient temperatures during and after sample collection, as well as time/date (hh.mm yy/mm/dd) at which the sampler recorded the deviation. The sampler writes the final information to these fields when the user presses <F4: Run/Stp> in the Main screen to return to the Stop Operating Mode.
AmbT	The sampler displays the minimum, average and maximum ambient temperatures (°C) encountered during sampling in the line labeled "AmbT."
FltT	The sampler shows the minimum, average and maximum filter temperatures (°C) encountered during sampling in the line labeled "FltT."
Pres	The sampler indicates the minimum, average and maximum ambient pressures (mm Hg) encountered during sampling in the line labeled "Pres."
AveFlow	The unit shows the average volumetric flow rate (l/min) during the sampling period in the AveFlow field.
Vol	The Vol field displays the total volume (m^3 at ambient conditions) sampled through the collection filter.
%CV	The coefficient of variation is equal to the standard deviation of the five-minute flow rate averages divided by the average flow rate (16.7 l/min by

default). This value is then divided by 100 to yield the %CV value shown in the Filter Data screen. If this value is greater than 4 (4%), the sampler displays the "C" status code (Section 6.1).

The Power Outages screen (Figure 8-2) contains the following additional information for each record of filter data:

Rec	The number of the current record is displayed in the upper right-hand corner of the screen.
Times	The screen contains up to ten time fields (hh.mm) that indicate the starting time of all power outages longer than 60 sec that occur during sampling.
ID1, ID2	The ID1 and ID2 fields display the user-defined information entered prior to sampling in the Filter Setup Screen (Section 5.2).

Figure 8-2. Power Outages screen.

```
            Power Outages/Misc   Rec: 937
  9.53    xx.xx    xx.xx    xx.xx    xx.xx
 xx.xx    xx.xx    xx.xx    xx.xx    xx.xx

ID1: "96                                 "
ID2: "00154                              "
```

	-	+	FiltDat	IntvDat	>

Function Keys in Browse Mode

	-	+	FiltDat	IntvDat	>
First			Last		<

The soft keys of the Filter Data screen and Power Outages screen have the following effects upon the location of the viewing pointer:

<F6: First>	First record.
<F2: ->	One record to the "left."
<F3: +>	One record to the "right."
<F9: Last>	Last record.

Pressing <F10: Output> when in the Filter Data screen allows the user to download records from the current position of the viewing pointer to the last record of the database through the RS232 port of the Partisol-FRM Sampler. Press <F10: Output> again to interrupt the downloading of information before reaching the last record. Refer to Section 8.3 for a detailed discussion of this downloading feature.

8.2. INTERVAL DATA

✔ The Partisol-FRM Sampler stores one record of interval data every five minutes whenever the unit is turned on.

The sampler stores five-minute averaged ambient temperature, filter temperature and ambient pressure as interval data. It writes a new record of interval data every five minutes on a continuous basis, and has a capacity of two weeks before it overwrites the oldest records. The sampler displays interval data records in the Interval Data screen (Figure 8-3).

Figure 8-3. Interval Data screen.

```
              Interval Data    Rec: 5674
          Time: 10.35 96/11/07

         Average Amb Temp:  17.2 C
        Average Filt Temp:  17.4 C
         Average Amb Pres:   760 mmHg
             Average Flow:  16.7 l/min
```

--	-	+	++	FiltDat	>
Function Keys in Browse Mode					
--	-	+	++	FiltDat	>
First	---	+++	Last	Output	<

The sampler displays the following information in the Interval Data screen:

Rec	The number of the current record is displayed in the upper right-hand corner of the screen.
Time	The ending time/date (hh.mm yy/mm/dd) of the five minute interval whose information is being displayed.
Amb Temp	The Amb Temp field displays the five-minute average of the ambient temperature (°C).
Filt Temp	The Filt Temp field displays the five-minute average of the filter temperature (°C).
Amb Pres	The Amb Pres field displays the five-minute average of the ambient pressure (mm Hg).

Ave Flow	The Flow field displays the five-minute average of the sample flow rate (volumetric l/min).

The soft keys of the Interval Data screen have the following effects upon the location of the viewing pointer (remember to use the shift key to access F6-F10):

<F6: First>	First record.
<F7: --->	One hundred records to the “left.”
<F1: -->	Ten records to the “left.”
<F2: ->	One record to the “left.”
<F3: +>	One record to the “right.”
<F4: ++>	Ten records to the “right.”
<F8: +++>	One hundred records to the “right.”
<F9: Last>	Last record.

Pressing (Shift ,F:5>) <F10: Output> when in the Interval Data screen allows the user to download records from the current position of the viewing pointer to the last record of the database through the RS232 port of the Partisol-FRM Sampler. Press <F10: Output> again to interrupt the downloading of information before reaching the last record. Refer to Section 8.3 for a detailed discussion of this downloading feature.

8.3. Downloading Stored Data

The Filter Data screen (Figure 8-1) and Interval Data screen (Figure 8-3) contain the <F10: Output> key to download stored data through the sampler's RS232 port to another serial device.

R&P supplies the Partisol-FRM Sampler with AKCOMM software (41-004001) and a 9-to-9 pin computer cable (07-000587) to enable the creation of data files containing stored information on a personal computer. The AKCOMM software diskette contains an instructional data file describing the program's use. Alternately, other commercially-available software may be used to receive and store transferred information on a personal computer (PC).

Attach the ends of the 9-to-9 pin computer cable to the RS232 port of the Partisol-FRM Sampler and the RS232 connector of a PC to link the two devices. Then ensure that the Baud Rate, Config and XON/XOff Cont RS232 parameters displayed in the RS232 Setup screen (Section 9.2) are appropriately defined for the software being employed.

✔ Pressing <F10: Output> while in the Filter Data or Interval Data Screen is a convenient way to download stored information.

The <F10: Output> keystroke allows the user to download records from the current position of the viewing pointer to the last record when in the Filter Data screen (Figure 8-1) or Interval Data screen (Figure 8-3). Pressing <F10: Output> again prior to completing the download cancels the data transfer.

The following text describes the format of the fields contained in each record of filter and interval data downloaded by the sampler.

8.3.1. Format of Filter Data Records

Each record of filter data contains the comma-delimited data fields shown below. Records are separated from each other by the “carriage return” (ASCII 013) and “line feed” (ASCII 010) characters.

ID1 (“ ” or “xx”)
ID2 (“ ” or “xx”)
Set Start Date ("yy/mm/dd")
Set Start Time (hh.mm)
Actual Start Date ("yy/mm/dd")
Actual Start Time (hh.mm)
Set Stop Date ("yy/mm/dd")
Set Stop Time (hh.mm)
Total Sample Time (hh.mm)
Average Flow Rate (l/min)
Flow Coefficient of Variation (%)
Sampled Volume (m^3)
Minimum Ambient Temperature (°C)
Average Ambient Temperature (°C)
Maximum Ambient Temperature (°C)
Minimum Filter Temperature (°C)
Average Filter Temperature (°C)
Maximum Filter Temperature (°C)
Minimum Ambient Pressure (mm Hg)
Average Ambient Pressure (mm Hg)
Maximum Ambient Pressure (mm Hg)
Maximum Temperature Differential (°C)
Date of Maximum Temp Differential ("yy/mm/dd")
Time of Maximum Temp Differential (hh.mm)
Status Codes (“xxx”)

✔ The sampler includes the status codes field and/or power interruption fields only for the number of events that occurred.

Beginning Time of Power Interruption 1 (hh.mm), see below
Beginning Time of Power Interruption 2 (hh.mm), see below
Beginning Time of Power Interruption 3 (hh.mm), see below
Beginning Time of Power Interruption 4 (hh.mm), see below
Beginning Time of Power Interruption 5 (hh.mm), see below
Beginning Time of Power Interruption 6 (hh.mm), see below
Beginning Time of Power Interruption 7 (hh.mm), see below
Beginning Time of Power Interruption 8 (hh.mm), see below
Beginning Time of Power Interruption 9 (hh.mm), see below
Beginning Time of Power Interruption 10 (hh.mm), see below

The number of fields in each record of filter data varies, depending upon the number of status codes and/or power interruptions recorded. If the sampler did not experience any status codes or power interruptions during sampling, the sampler omits all of the status codes and power interruption fields. Otherwise, filter data records contain fields for only the number of status codes and/or power interruptions encountered.

8.3.2. Format of Interval Data Records

Each record of interval data contains the comma-delimited data fields shown below. Records are separated from each other by the "carriage return" (ASCII 013) and "line feed" (ASCII 010) characters.

Date at End of 5-Minute Period ("yy/mm/dd")
Time at End of 5-Minute Period (hh.mm)
5-Minute Average Ambient Temperature (°C)
5-Minute Average Filter Temperature (°C)
5-Minute Average Ambient Pressure (mm Hg)
5-Minute Average Sample Flow Rate (volumetric l/min)

Section 9: Data Output

This section describes the continuous analog voltage signal generated by the Partisol-FRM Sampler to indicate flow rate and the existence of any status conditions, as well as the setup of the hardware's RS232 interface. The bidirectional AK communication protocol (Appendix D) implemented in the sampler's RS232 port allows users to retrieve the current values of system variables, set new values for operating parameters, as well as retrieve stored filter and interval data (Section 8).

9.1. User Analog Output

✔ The sampler's analog voltage output provides a continuous feedback of the unit's current sample flow rate and status condition.

The four-pin connector on the back panel of the Partisol-FRM Sampler labeled "User Output" transmits a continuous 0-5 VDC analog voltage signal whose level reflects the current sample flow rate and the existence of any status conditions. The voltage output is determined in the following manner:

0-2.0 VDC	No status conditions. If there are no current status conditions, the voltage output equals the current sample flow rate divided by 10. Therefore, if the current flow rate is 0 l/min, the output is 0 VDC. At the default sampling flow rate of 16.7 l/min, the analog output is 1.67 VDC.
2.5-4.5 VDC	Existence of one or more status conditions. If there is a current status condition, the voltage output equals 2.5 VDC *plus* the current sample flow rate divided by 10. Therefore, if the current flow rate is 0 l/min, the output is 2.5 VDC. At the default sampling flow rate of 16.7 l/min, the analog output is 4.17 VDC.

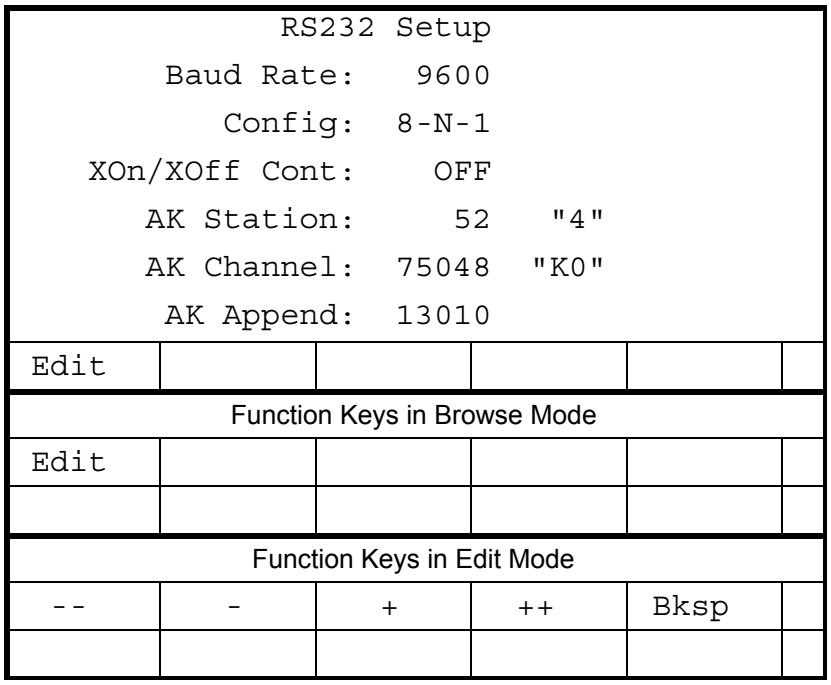
Appendix C details the pin assignments of the four-pin User Output connector, as well as the assembly diagram for the mating connector (06-002453) supplied with each sampler.

9.2. Configuring the RS232 Port

The settings in the RS232 Setup screen (Figure 9-1) define the hardware and software configuration of the system's RS232 port. When in the Main screen, press <F5: Setup> and then <F4: RS232> to display the RS232 Setup screen. The fields of this screen are editable in any of the unit's operating modes.

Appendix C contains a listing of the pin assignments of the sampler's 9-pin RS232 port.

Figure 9-1. RS232 Setup screen.



The RS232 Setup screen (Figure 9-1) contains the following user-definable fields.

✔ The Baud Rate, Config and XOn/XOff Cont parameters must match the settings of the personal computer or other serial device connected to the sampler.

Baud Rate This is the data transmission rate (baud, bits per second). Use the <F2: -> and <F3: +> keys to select the appropriate baud rate when in the Edit Mode. The default setting of this parameter is 9600.

Config This parameter represents the data transfer format (data bits-parity-stop bits). Use the <F2: -> and <F3: +> keys to select between "8-N-1" and "7-E-1"when in the Edit Mode. The default setting of this parameter is "8-N-1" (8 stop bits, no parity, 1 stop bit).

XOn/XOff Cont The user may turn software data flow control on or off by pressing the <F2: -> and <F3: +> keys when in the Edit Mode. The default setting of this parameter is "OFF."

✔ The sampler only uses the AK Station, AK Channel and AK Append parameters when using the AK Protocol described in Appendix D.

AK Station This is the ASCII code for the one-digit Station Number used by the AK Protocol (Appendix D). The default value of this parameter in the sampler and AKCOMM software is 52, which is the ASCII representation for "4." This parameter is *not* used when performing the data downloading described in Section 7.3.

AK Channel	This is the ASCII code representation of the two-digit Channel number used by the AK Protocol (Appendix D). The default value of this parameter in the sampler and AKCOMM software is 75048, which is the ASCII representation for "K0" (the capital letter "K" and the number "0"). This parameter is *not* used when performing the data downloading described in Section 8.3.
AK Append	This is the ASCII code representation of characters added between response lines from the sampler when using the AK Protocol (Appendix D). This parameter is optional, and should have a value of 0 if nothing is to be appended. The default value of this parameter is 13010, which represents CR (carriage return) and LF (line feed). This parameter is *not* used when performing the data downloading described in Section 8.3.

The Baud Rate, Config, and XOn/XOff Cont parameters above not only define data transmission when using the AK Protocol, but are also used by the Partisol-FRM Sampler when downloading data directly from the Filter Data screen and Interval Data screen (Section 8.3).

The AK Protocol described in Appendix D provides a means of communicating with the hardware from a connected personal computer (PC) or by modem from a remote location. When using the AK Protocol to download stored filter or interval data from the sampler, set the value of program register code (PRC) 38 to either "1" or "2" using the EREG command to point to the filter data buffer and interval data buffer, respectively. The fields that are contained in the filter and interval data records downloaded using the AK Protocol's ASTO command are listed in Section 8.3, and are the same as when the user downloads data records directly.

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Section 10: Routine Maintenance and Verification Procedures

This section describes the routine maintenance and performance verification procedures required to maintain the consistent operation of the Partisol-FRM Sampler.

10.1. Routine Maintenance Procedures

The routine maintenance of the Partisol-FRM Sampler consists of the following procedures performed at the indicated intervals (U.S. EPA 2.12 Quality Handbook, Section 9):

Filter cassettes	Inspect filter cassettes for contamination *after every use*. Wipe with a clean dry cloth as required. Additional filter cassettes can be ordered from R&P (59-004648-0001).
Upper and lower cassette seals	Inspect the seals that rest against the filter cassette *every time a filter is exchanged*. Wipe the seals with a clean dry cloth as required. Inspect the seals once a year for drying and cracking, and replace them if necessary (22-002182).
External leak check	Perform an external leak check *after every 5 days of inlet usage* (Section 10.2.4).
Internal leak check	Perform an internal leak check *after every 4 weeks or every month of inlet usage* (Section 10.2.6).
WINS PM-2.5 impactor	Clean the greased impactor section of the WINS PM-2.5 impactor *after every 5 days of inlet usage* (Appendix H.2). The impactor must be cleaned when the unit is not sampling.
PM-10 inlet	Clean the PM-10 inlet *after every 14 days of inlet usage* (Appendix H.1). The inlet must be cleaned when the unit is not sampling.
Large in-line filter	Exchange the large in-line filter in the sampler *every six months* of operation (32-002643). Turn off the sampler (Section 5.4) to replace the large in-line filter.
Air screens	Clean the air screens located under the sampler's rain hoods *every 6 months* of operation.

Battery voltage	Check the voltage level of the batteries on the main computer board in the electronics compartment *every six months* (Appendix F.1).

The pump in the Partisol-FRM Sampler has a limited lifetime of approximately 2 years. If the pump's performance deteriorates, it should be rebuilt using the Partisol Pump Rebuild Kit (32-W8419) or replaced with a new pump (Appendix F).

10.2. Performance Verification Procedures

R&P recommends that the user perform the routine maintenance procedures described in Section 10.1 at the same time as the audits explained below.

> NOTE: The user can access the Audit screen (Figure 10-1) only when the sampler is in the Stop Operating Mode. Refer to Section 5.3 for an explanation of the sampler's operating modes.

10.2.1. Ambient Temperature Audit

Follow these steps to perform an ambient temperature audit:

NOTE: Refer to Section 6 of the U.S. EPA 2.12 Quality Assurance Handbook for further information on the ambient temperature sensor audit.

1) When in the Setup screen, press <F5: Audit> to display the Audit screen (Figure 10-1).

Figure 10-1. Audit screen.

```
                    Audit

 Amb Temp:  25.4 C        Amb Pres:  753 mm Hg

Filt Temp:  25.6 C        Sys Pres:  N/A mm Hg

 FTS Pres:  0.00 in H2O   Cur Flow:  -0.3 l/min

 FTS Flow:  0.00 l/min
```

Edit	Valve	Pump		LeakCk	

2) Determine the current temperature (°C) at the ambient temperature sensor using an external thermometer (°C = 5/9 x (°F - 32)).

3) Verify that the value for temperature displayed as "Ambient Temp" in the Audit screen is within ±2° C of the measured temperature. If this is not the case, perform the ambient temperature calibration procedure (Section 11).

10.2.2. Filter Temperature Audit

Follow these steps to perform a filter temperature audit:

NOTE: Refer to Section 6 of the U.S. EPA 2.12 Quality Assurance Handbook for further information on the filter temperature audit.

1) **When in the Setup screen, press <F5:Audit> to display the Audit screen (Figure 10-1)**
2) **Determine the current temperature (°C) at the location of the sample filter in the Partisol-FRM Sampler using an external thermometer (°C = 5/9 x (°F - 32)).**
3) **Verify that the value for temperature displayed as "Filter Temp" in the Audit screen is within ±2° C of the measured temperature. If this is not the case, perform the filter temperature calibration procedure (Section 11).**

10.2.3. PRESSURE AUDIT

Follow these steps to perform an ambient pressure audit:

1) **When in the Setup screen, press <F5: Audit> to display the Audit screen (Figure 10-1).**

2) **Determine the current ambient station pressure in mm Hg (absolute pressure, not corrected to sea level).**

   - To convert from Atmospheres @ 0 °C to mm Hg, multiply by 760.
   - To convert from millibars to mm Hg, multiply by 0.75012.
   - To convert from inches Hg @ 32 °F to mm Hg, multiply by 25.4.

3) **Verify that the value for "Ambient Pres" in the Audit screen is within ±10 mm Hg of the measured ambient pressure. If this is not the case, perform the ambient pressure calibration procedure (Section 11).**

10.2.4. External Leak Check

Although the Audit screen (Figure 10-1) contains a <F5: LeakCk> soft function key, your Partisol-FRM Sampler may not support the automatic leak check function. Follow the instructions in Section 10.2.4.1 to determine whether your unit supports this function.

10.2.4.1. Automatic External Leak Check

Follow these steps to perform an automatic external leak check:

1) **When in the Setup screen, press <F5: Audit> to display the Audit screen (Figure 10-1).**
2) **Remove the PM-10 inlet from the sampler.**
3) **Install a filter cassette containing a new 47 mm filter into the unit.**
4) **Install the flow audit adapter (Figure 10-2) (57-000618) onto the end of the sample tube of the sampler. Ensure that the valve on the flow audit adapter is in the open position.**

Figure 10-2. Flow audit adapter installed onto the end of the sample tube.

5) Press the <F5: LeakCk> soft function key. If the sampler does not support the automatic external leak check function, it will display a "System does not support auto leak check" message (Figure 10-3). If your sampler displays this message, go to Section 10.2.4.2. If the sampler does support an automatic external leak check function, go to step 6.

Figure 10-3. Audit screen with "System does not support auto leak check" message.

```
                    Audit
 Amb Temp:  25.4 C       Amb Pres:  753 mm Hg
Filt Temp:  25.6 C       Sys Pres:  N/A mm Hg
 FTS Pres:  0.00 in H2O  Cur Flow:  -0.3 l/min
 FTS Flow:  0.00 l/min

 System does not support auto leak check.
```

Edit	Valve	Pump		LeakCk	

6) Press the <ENTER> key.

7) Turn the valve on the flow audit adapter to its closed position (Figure 10-2).

8) Press the <ENTER> key.

9) Shut off the flow to the flow controller assembly by turning the manual shut-off valve (flow control manual valve) that is attached to the large air filter on the left-hand side of the manifold in the hub. This corresponds to location "A" in Figure 10-4.

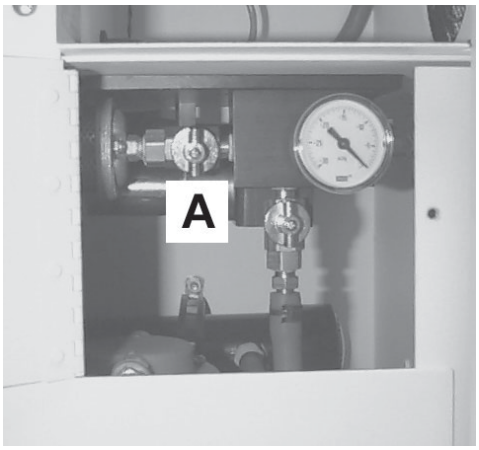


Figure 10-4. Flow control manual valve (A) in the closed position.

10) Press the <ENTER> key. The system will now pull a vacuum and begin a 30 second leak check cycle. At the end of the cycle, a "Leak Check Pass" or "Leak Check Fail" message will display on the screen. If the leak check fails, the unit will display the actual measure of vacuum loss. The pass criteria is a loss of 15 inches (381 mm Hg) or less. If the leak check fails, go to step 11. If the leak check passes, go to step 12.

11) Replace the filter cassette with a new filter cassette and repeat the leak check procedure. If the leak check fails a second time, refer to Section 11.

12) Open the flow controller manual valve that you closed in step 9.

13) Slowly open the valve of the flow audit adapter.

14) If you will be performing a flow audit (Section 10.2.5) immediately, go to Section 10.2.5. If you will not be performing a flow audit, go to step 15.

15) Remove the flow audit adapter from the end of the sample tube.

16) Install the PM-10 inlet onto the end of the sample tube.

17) Remove the filter cassette from the sampler and discard the 47mm filter used during the external leak check.

10.2.4.2. Manual External Leak Check

Follow these steps to perform a manual external leak test:

1) **When in the Setup screen, press <F5: Audit> to display the Audit screen (Figure 10-1).**
2) **Remove the PM-10 inlet from the sampler.**
3) **Install a filter cassette containing a new 47 mm filter into the unit.**
4) **Install the flow audit adapter (Figure 10-2) (57-000618) onto the end of the sample tube of the sampler. Ensure that the valve on the flow audit adapter is in the open position.**
5) **Press <F2: Valve>.**
6) **Press <F3: Pump>.**
7) **Turn the valve on the flow audit adapter to its closed position (Figure 10-2).**
8) **Shut off the flow to the flow controller assembly by turning the manual shut-off valve (flow control manual valve) that is attached to the large air filter on the left-hand side of the manifold in the hub. This corresponds to location "A" in Figure 10-4.**
9) **Watch the vacuum gauge and record the reading on the vacuum gauge when it becomes stable. The gauge should read at least 15 inches H_2O (381 mm Hg).**
10) **Shut off the flow to the pump by turning the other manual shut-off valve (pump manual valve) located on the bottom of the manifold in the hub.**
11) **Press <F3: Pump>.**
12) **Record the reading on the vacuum gauge. This reading should not drop by more than 8.5 inches Hg during this 30 second period. This corresponds to a leak of 80 ml/min. If the reading does drop by more than 8.5 inches Hg during this 30 second period, trace the internal (and external) flow paths to identify problems in tubing or connections.**
13) **Open the flow controller manual valve and pump manual valve that you closed in steps 8 and 10.**
14) **Slowly open the valve of the flow audit adapter.**
15) **Press <F2: Valve>.**

16) If you will be performing a flow audit (Section 10.2.5) immediately, go to Section 10.2.5. If you will not be performing a flow audit, go to step 17.

17) Remove the flow audit adapter from the end of the sample tube.

18) Install the PM-10 inlet onto the end of the sample tube.

19) Remove the filter cassette from the sampler and discard the 47mm filter used during the external leak check.

10.2.5. FLOW AUDIT

Perform the ambient temperature audit (Section 10.2.1), filter temperature audit (Section 10.2.2), pressure audit (Section 10.2.3) and external leak check (Section 10.2.4) before executing the flow audit procedure.

Follow these steps to perform a flow audit:

1) **When in the Setup screen, press <F5: Audit> to display the Audit screen (Figure 10-1).**
2) **Install a filter cassette containing a 47 mm filter into the hardware. This filter will be thrown away at the end of this flow audit.**
3) **Remove the PM-10 inlet from the end of the sample tube.**
4) **If you are using the Streamline Flow Transfer Standard (FTS) to audit the flow of the Partisol-FRM Sampler, go to step 5. If you are not using the Streamline FTS to audit the flow of the Partisol-FRM Sampler, go to step 13.**
5) **Press the <ESC> key to display the Setup screen.**
6) **When in the Setup screen, press <F1:EDIT>.**
7) **Press the down (<↓>) arrow to display the "FTS CONST m" field.**
8) **Locate the "m" constant on the FTS Calibration sheet, and enter it into the "FTS CONST m" field.**
9) **Press the down (<↓>) arrow to display the "FTS CONST b" field.**
10) **Locate the "b" constant on the FTS Calibration sheet, and enter it into the "FTS CONST b" field.**
11) **Press the <ENTER> key.**
12) **Press <F5: Audit> to display the Audit screen. Go to step 13.**
13) **If you are using the Streamline FTS to audit the flow of the Partisol-FRM Sampler, install the Streamline FTS onto the end of the sample tube (Figure 10-5). If you are not using the Streamline FTS to audit the flow of the Partisol-FRM Sampler, you may need to install the flow audit adapter (57-000618) onto the end of the sample tube (Figure 10-2). If you will be using the flow audit adapter, ensure that you install it onto the end of the sample tube with its valve in the open position.**

Figure 10-5. Streamline FTS installed onto the end of the sample tube.

14) Press <F3:Pump>.

15) Press <F2: Valve>.

16) If you are using the Streamline FTS, go to step 17. If you are not using the Streamline FTS, go to step 19.

17) Press <F1: Edit>.

18) Enter the pressure drop (inches H_2O) in the "FTS Pres" field, and then press the <ENTER> key. The unit will automatically calculate the flow (l/min) and display it in the "FTS Flow" field. Go to step 21.

19) Determine the flow in units of actual (volumetric) l/min using the external flow meter.

20) Verify that this flow matches the value displayed in the "Flow Rate" field to within ±4%. If the flow rate measured on the flow meter matches the value displayed in the "Flow Rate" field to within ±4%, go to step 21. If the flow rate measured on the flow meter does not match the value displayed in the "Flow Rate" field to within ±4%, perform the flow calibration procedure (Section 11).

21 Verify that the flow rate measured on the flow meter matches the sampler's original flow design value (16.7 l/min) to within ±5%. If the flow rate measured on the flow meter matches the sampler's original flow design value (16.7 l/min) to within ±5%, go to step 22. If the flow rate measured on the flow meter does not match the sampler's original flow design value (16.7 l/min) to within ±5%, calibrate the external flow meter.

22) Return to the Main screen by pressing the <ESC> key twice.

23) Remove the flow metering hardware.

24) Install the PM-10 inlet onto the end of the sample tube.

25) Remove the filter cassette from the sampler and discard the 47 mm filter.

10.2.6. Internal Leak Test

Follow these steps to perform an internal leak check:

1) **Clean the filter cassette with a clean cloth and alcohol to remove any oil or other material.**
2) **Insert a leak check disk (36-004768) into the filter cassette.**
3) **Install the filter cassette into the sampler and push on the handle to move the filter cassette into the sampling position.**
4) **When in the Setup screen, press <F5: Audit> to display the Audit screen (Figure 10-1).**
5) **Press <F2: Valve>.**
6) **Press <F3: Pump>.**
7) **Shut off the flow to the flow controller assembly by turning the manual shut-off valve (flow control manual valve) that is attached to the large air filter on the left-hand side of the manifold in the hub. This corresponds to location "A" in Figure 10-4.**
8) **Record the reading on the vacuum gauge.**
9) **Shut off the flow to the pump by turning the other manual shut-off valve (pump manual valve) located on the bottom of the manifold in the hub.**
10) **Press <F3: Pump>.**
11) **Record the reading on the vacuum gauge. This reading should not drop by more than 8.5 inches Hg during this 30 second period. This corresponds to a leak of 80 ml/min. If the reading does drop by more than 8.5 inches Hg during this 30 second period, trace the internal flow paths to identify problems in tubing or connections.**
12) **Press <F2: Valve>.**
13) **Open the flow controller manual valve and pump manual valve that you closed in steps 7 and 9.**
14) **Slowly open the valve of the flow audit adapter.**
15) **Remove the flow audit adapter from the end of the sample tube.**
16) **Install the PM-10 inlet onto the end of the sample tube.**
17) **Remove the filter cassette from the sampler.**
18) **Remove the leak check disk from the filter cassette.**

Section 11: Calibration Procedures

This section contains instructions for performing an interface board, ambient temperature, filter temperature, ambient pressure, and flow calibration of the Partisol-FRM Sampler. The temperature and pressure calibrations must be done before the flow calibration.

R&P recommends that these procedures be executed on an annual basis. Individual monitoring organizations, however, may have different guidelines.

11.1. Interface Board Calibration

IMPORTANT: Use proper anti-static protection when the door to the electronics compartment is open and when taking measurements on any electronic components. Failure to use anti-static protection could result in damage to electronic components.

Follow these steps to calibrate the interface board:

1) Locate the interface board on the bottom panel of the sampler's electronics compartment (Figure 11-1).

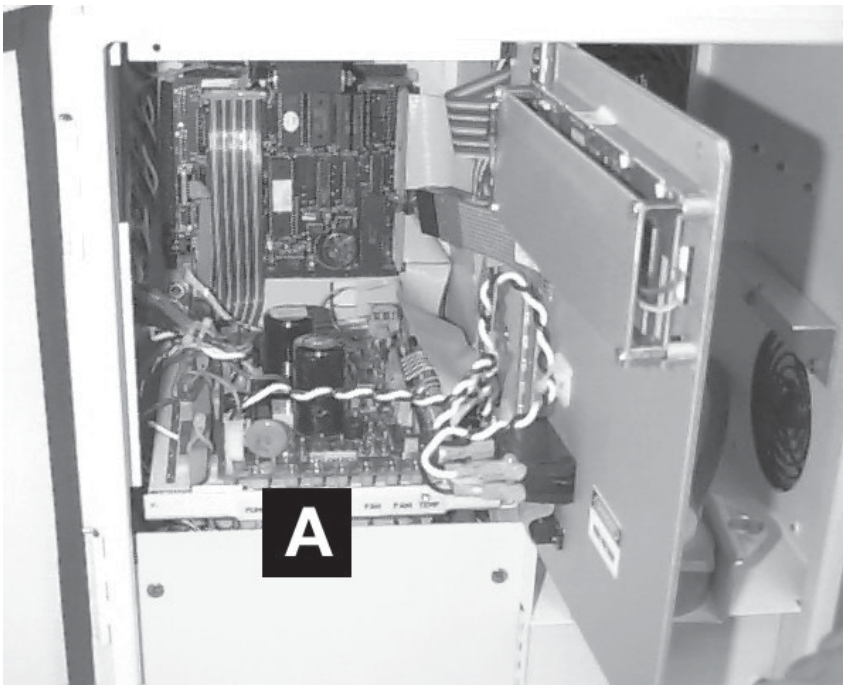
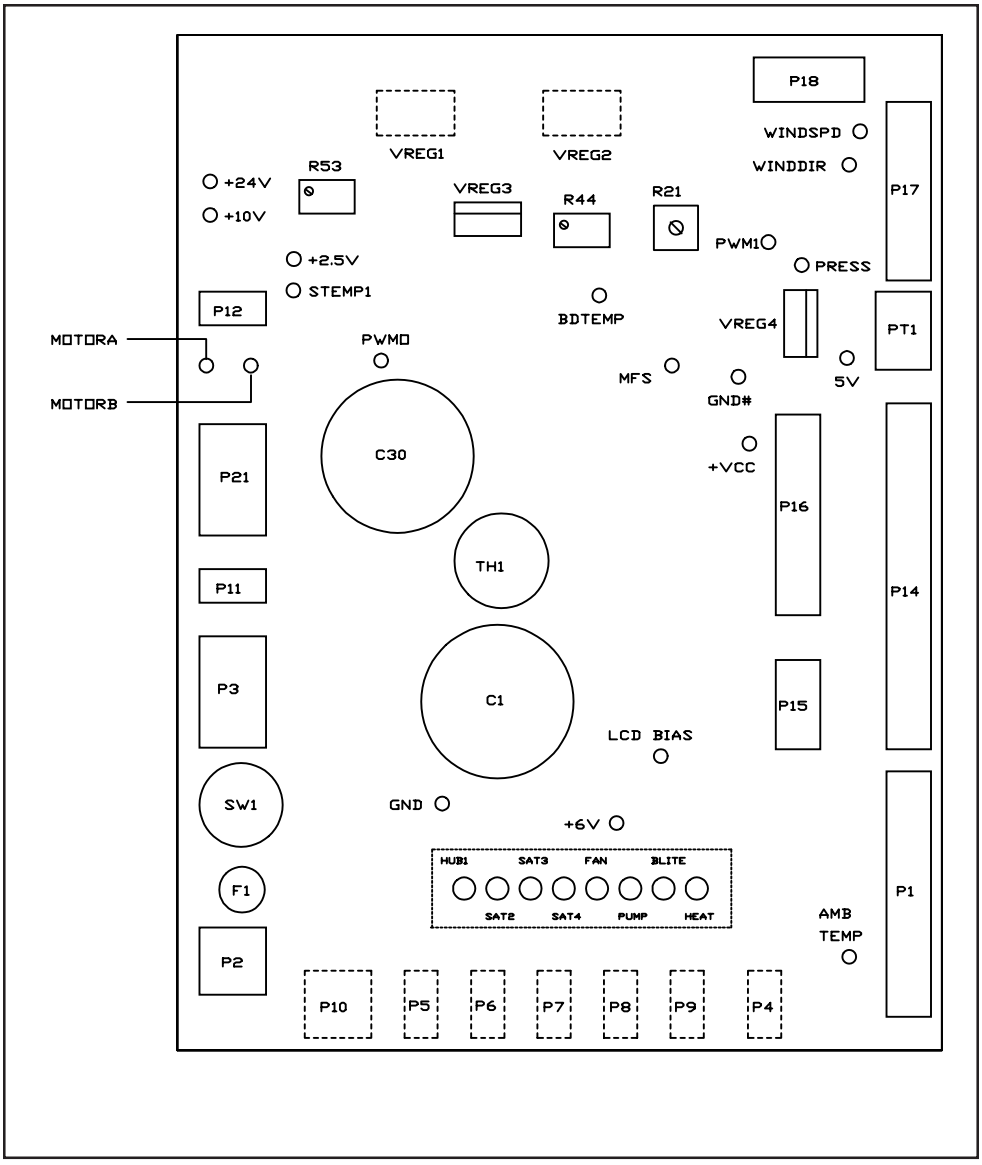


Figure 11-1. Location of interface board (A) inside the electronics compartment.

2) Locate the test point labeled "+6V" in the front section of the interface board (Figure 11-2), and the "+2.5V" and "+10V" test point in the back part. All three test points are red.

Figure 11-1. Interface board layout.



3) Locate the black ground test point labeled "GND" in the front portion of the interface board.

4) Ensure that the sampler is turned on and that the display backlight is on. The backlight *must* be on during the +6 V calibration. If the backlight is off, press any key on the keypad to turn it on.

5) Place the positive lead of a multimeter on the +6 V test point.

6) Place the ground lead on the ground test point.

7) Locate R21 on the rear section of the interface board. R21 is a horizontal pot, and its designation "R21" is silk-screened on the board.

8) Adjust R21 until the multimeter reads 6.00 VDC ± 0.05 V.

9) Place the positive lead on the +2.5V test point.

10) Locate R53 on the rear section of the interface board. R53 is a blue vertical pot, and its R53 designation is silkscreened on the board.

11) Adjust R53 until the multimeter reads 2.500 VDC ± 0.002 V

12) Place the positive lead of the multimeter on the +10 V test point.

13) Locate R44 on the rear section of the interface board. R44 is a blue vertical pot, and its designation "R44" is silk-screened on the board.

14) Adjust R44 until the multimeter reads 10.000 VDC ± 0.002 V.

11.2. Analog Input Calibration

Please note that the following procedure must be performed *after* the interface board calibration and *before* the temperature, pressure and flow calibrations.

> **IMPORTANT:** Use proper anti-static protection when the door to the electronics compartment is open and when taking measurements on any electronic components. Failure to use anti-static protection could result in damage to electronic components.

Follow these steps to perform an analog input calibration:

1) **Return the sampler to the Main screen (Section 4.3).**
2) **The device must be in the Stop Operating Mode (Section 5.3) to perform an analog input calibration.**
3) **When in the Main screen, press <F5: Setup> and then <F2: Calib> to display the Calibration screen (Figure 11-3).**

Figure 11-4. Calibration screen.

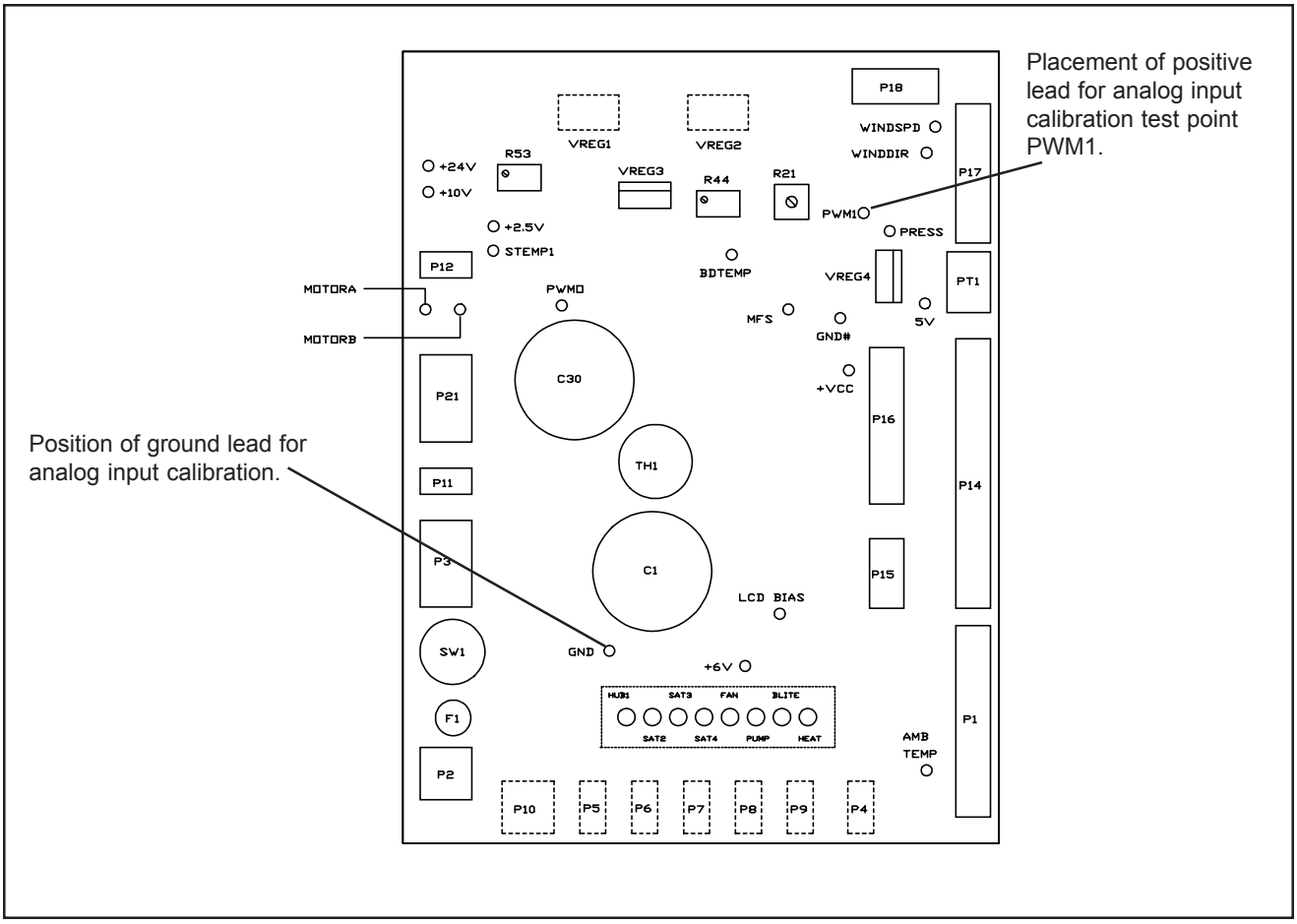
Stat:Ok Calibration Mode:SAMP					
Calc Act Offset Span					
A/I: 0.000 0.000 0.0000 1.0000 A/O:0.00					
AmbT: 23.2 0.0 0.0000					
FltT: 23.6 0.0 0.0000 FTS Pres:					
Pres: 760 0 0.0000 0.00					
Flow: 16.7 0.0 0.0000 1.0000					
Edit	FlowCal				>
Function Keys in Browse Mode					
Edit	FlowCal				>
Edit	Flow	DecFlow	HldFlow	IncFlow	<
Function Keys in Edit Mode					
--	-	+	++	Bksp	>
+/-					<

4) Locate connector P18 in the back section of the interface board. Unplug the cable connected to P18.

5) Plug the analog input calibration cable into P18.

6) Attach the positive lead from a multimeter with four-digit resolution to the green test point labeled "PWM1" on the interface board. Attach the ground lead to the ground test point (Figure 11-4).

Figure 11-4. Lead locations on the interface board.



7) When in the Calibration screen, press the arrow key to position the cursor so that it is in the "A/O" field.

8) Press <F1: Edit> to enter the Edit Mode. Enter a number between "0.050" and "0.150" volts and press the <ENTER> key.

9) Watch the value displayed in the row labeled "A/I," under the column labeled "Calc." Ensure that this value does not vary by more than ±0.005 volts after watching it for 5 seconds. If this number is not stable, choose a new number for "A/O" between "0.050" and "0.150" volts.

10) Read the voltage displayed on the multimeter.

11) Using the arrow keys, position the cursor so that it is in the row labeled "A/I" under the column labeled "Act."

12) Press <F1: Edit> to enter the Edit Mode. Enter the voltage reading from the multimeter (to three digit accuracy, i.e., 0.xxx) in this position and press the <ENTER> key. The unit will now calculate the "Offset" value.

13) Ensure that the value now displayed in the row labeled "A/I" under the column labeled "Calc" matches the value displayed on the multimeter, within ±0.005 volts.

14) Using the arrow key, position the cursor so that it is in the "A/O" field.

15) Press <F1: Edit> to enter the Edit Mode. Enter a number between "4.800" and "4.900" volts and press the <ENTER> key.

16) Observe the value displayed in the row labeled "A/I" under the column labeled "Calc." Ensure that this value does not vary by more than ±0.005 volts after watching it for 5 seconds. If this number is not stable, choose a new number for "A/O" between "4.800" and "4.900" volts.

17) Read the voltage displayed on the multimeter.

18) Using the arrow keys, position the cursor so that it is in the row labeled "A/I" under the column labeled "Act."

19) Press <F1: Edit> to enter the Edit Mode. Enter the voltage reading from the multimeter (to three digit accuracy, i.e., 0.xxx) in this position and press the <ENTER> key. The unit will now calculate the "Span" value.

20) Ensure that the value now displayed in the row labeled "A/I" under the column labeled "Calc" matches the value displayed on the multimeter within ±0.005 volts.

21) Remove the multimeter leads from the interface board, and the analog input calibration cable from the back of the electronics compartment.

22) After the user has performed the analog input calibration, they must now perform the temperature, pressure and flow calibrations.

NOTE: If the instrument has been reset and you have recorded the "Offset" and "Span" values for the flow, you may enter these numbers directly when in the Edit Mode.

11.3. Ambient Temperature Calibration

Follow these steps to calibrate the ambient temperature sensor:

NOTE: Refer to the U.S. EPA 2.12 Quality Assurance Handbook, Section 6.

1) **Return the sampler to the Main screen (Section 4.3).**
2) **The device must be in the Stop Operating Mode (Section 5.3) to perform an ambient temperature calibration.**
3) **When in the Main screen, press <F5: Setup> and <F2: Calib> to display the Calibration screen (Figure 11-3).**
4) **Determine the current temperature (°C) at the ambient temperature sensor using an external thermometer, [°C = 5/9 x (°F - 32)].**
5) **Press <F1: Edit> to enter the Edit Mode, and move the cursor to the row labeled "AmbT" under the "Act" (actual) column.**
6) **Enter the current ambient temperature (°C) and press the <ENTER> key. If necessary, use the <F6: +/-> key (Shift F1>) to enter negative temperatures when in the Edit Mode.**
7) **Upon receiving the actual temperature, the system's microprocessor automatically computes the "Span" value for the ambient temperature. Record this value for future reference.**

NOTE: If the instrument has been reset and you have recorded the "Span" value for the ambient temperature, you may enter it directly in the "Span" column when in the Edit Mode.

11.4. Filter Temperature Calibration

Follow these steps to calibrate the filter temperature:

NOTE: Refer to the U.S. EPA 2.12 Quality Assurance Handbook, Section 6.

1) **Return the sampler to the Main screen (Section 4.3).**
2) **The device must be in the Stop Operating Mode (Section 5.3) to perform a filter temperature calibration.**
3) **When in the Main screen, press <F5: Setup> and <F2: Calib> to display the Calibration screen (Figure 11-3).**
4) **Determine the current temperature (°C) at the location of the sample filter in the Partisol-FRM Sampler using an external thermometer, [°C = 5/9 x (°F - 32)].**
5) **Press <F1: Edit> to enter the Edit Mode, and move the cursor to the row labeled "FltT" under the "Act" (actual) column.**
6) **Enter the current filter temperature (°C) and press the <ENTER> key. If necessary, use the <F6: +/-> key to enter negative temperatures when in the Edit Mode.**
7) **Upon receiving the actual temperature, the system's microprocessor automatically computes the "Span" value for the filter temperature. Record this value for future reference.**

NOTE: If the instrument has been reset and you have recorded the "Span" value for the filter temperature, you may enter it directly in the "Span" column when in the Edit Mode.

11.5. Ambient Pressure Calibration

Follow these steps to calibrate the ambient pressure sensor:

NOTE: Refer to the U.S. EPA 2.12 Quality Assurance Handbook, Section 6.

1) Return the sampler to the Main screen (Section 4.3).

2) The device must be in the Stop Operating Mode (Section 5.3) to perform an ambient pressure calibration.

3) When in the Main screen, press <F5: Setup> and <F2: Calib> to display the Calibration screen (Figure 11-3).

4) Determine the current ambient station pressure in mm Hg (absolute pressure, not corrected to sea level).

- To convert from Atmospheres @ 0 °C to mm Hg, multiply by 760.
- To convert from millibars to mm Hg, multiply by 0.75012.
- To convert from inches Hg @ 32 °F to mm Hg, multiply by 25.4.

5) Press <F1: Edit> to enter the Edit Mode, and move the cursor to the row labeled "Pres" under the "Act" (actual) column.

6) Enter the current ambient pressure (mm Hg) and press the <ENTER> key.

7) Upon receiving the actual pressure, the system's microprocessor automatically computes the "Span" value for the ambient pressure. Record this value for future reference.

NOTE: If the instrument has been reset and you have recorded the "Span" value for the ambient pressure, you may enter it directly in the "Span" column when in the Edit Mode.

11.6. Flow Calibration

The temperature and pressure calibrations described above *must* be performed before performing the flow calibration. In addition, the leak check discussed in Section 9.2.4 must also be undertaken before executing the following instructions.

The Partisol-FRM Sampler supports both a single-point and five-point flow calibration routine (refer to the U.S. EPA 2.12 Quality Assurance Handbook, Section 6).

R&P recommends that the user perform the flow calibration whenever the sampler has been transported, any electromechanical maintenance has been done, or the sampler flow deviates from the set flow by ±5%. The sampler should be calibrated at least once per calendar year.

11.6.1. Single-Point Flow Calibration

Follow these steps to perform the single-point flow calibration:

1) **Return the sampler to the Main screen (Section 4.3).**
2) **The device must be in the Stop Operating Mode (Section 5.3) to perform a single-point flow calibration.**
3) **Remove the PM-10 inlet from the sampler.**
4) **Install a filter cassette containing a 47 mm filter into the filter holding mechanism. This filter will be thrown away at the end of this flow calibration.**
5) **When in the Main screen, press <F5: Setup> and then <F2: Calib> to display the Calibration screen (Figure 11-3).**
6) **If you are using the Streamline Flow Transfer Standard (FTS) (Figure 11-5) to calibrate the flow of the Partisol-FRM Sampler, go to step 7. If you are not useing the the Streamline Flow Transfer Standard (FTS) to calibrate the flow of the Partisol-FRM Sampler, go to step 14.**

Figure 11-5. Calibrating the sampler's flow using the Streamline Flow Transfer Standard (FTS).

7) Press the <ESC> key to display the Setup screen.

8) Press <F1: Edit>.

9) Press the arrow keys to scroll down to the "FTS CONST" field.

10) Enter the "m" constant from the FTS Calibration sheet.

11) Enter the "b" constant from the FTS Calibration sheet.

12) Press the <ENTER> key.

13) Press <F2:Calib> to return to the Calibration screen.

14) Attach the Streamline FTS or other flow metering device to the sample tube. Other flow meters may require the use of the flow audit adapter, which should be installed with its valve open.

15) Leave the pump turned off. If it is currently on, press <F7: Flow> to turn it off.

16) Press <F1: Edit> to enter the Edit Mode, and move the cursor to the row labeled "Flow" under the "Act" (actual) column.

17) Enter "0" in this position and press the <ENTER> key. This causes the microprocessor to compute the "Offset" value, which is the zero offset value for the mass flow controller. Record this value for future reference.

18) Turn on the pump by pressing <F7: Flow>.

19) Press <F8: DecrFlow> to continuously decrease the flow, <F9: HoldFlow> to maintain the current flow rate, and <F10: IncrFlow> to continuously increase the flow, until the flow rate displayed in the "Calc" column of the Calibration screen is approximately 16.7 l/min.

20) Determine the flow in actual l/min using the external flow meter. If you are using the Streamline FTS, go to step 21. If you are not using the Streamline FTS, go to step 23.

21) Enter the pressure (inches H_2O) in the "FTS Pres" field by pressing <F1:Edit>, entering the value using the keypad, then pressing the <ENTER> key. The sampler will calculate the volumetric flow in l/min.

22) If you are using the Streamline FTS, the sampler will automatically display the calculated flow in the "ACT" field and compute the "Span" value. The "Span" value is the span offset value for the mass flow controller. Record this value for future reference. Go to step 25.

NOTE: If the instrument has been reset and you have recorded the "Offset" and "Span" values for the flow, you may enter these values directly when in the Edit Mode.

23) Press <F1: Edit> to enter the Edit Mode, and moving the cursor to the row labeled "Flow" under the "Act" (actual) column.

24) Enter the volumetric flow rate measured by the external flow meter and press the <ENTER> key. The unit will now compute the "Span" value, which is the span offset value for the mass flow controller. Record this value for future reference. Go to step 25.

NOTE: If the instrument has been reset and you have recorded the "Offset" and "Span" values for the flow, you may enter these values directly when in the Edit Mode.

25) Return to the Main screen by pressing the <ESC> key twice.

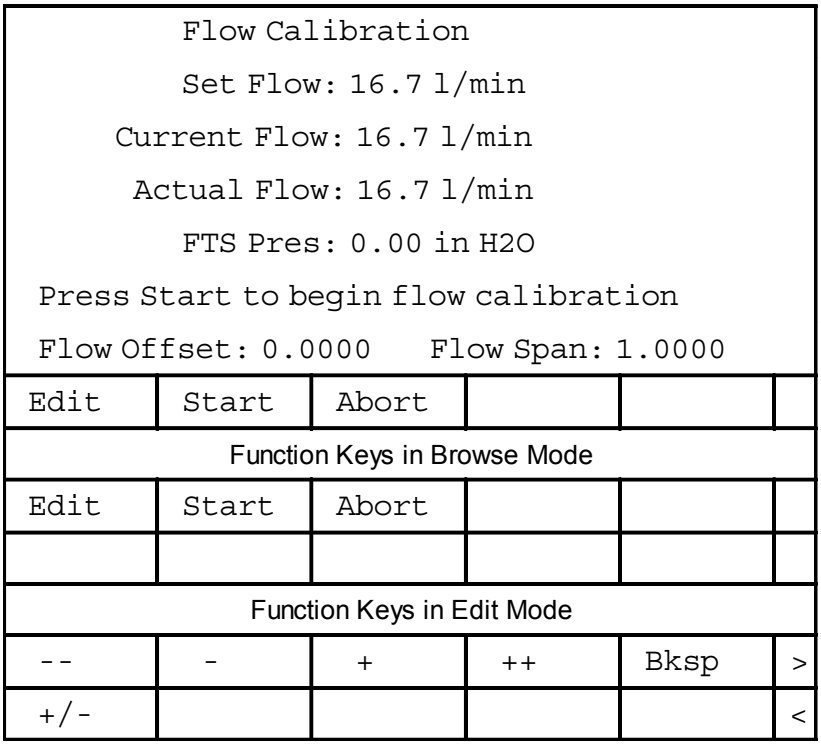
26) Restore the sampling hardware to its original state by removing the flow metering hardware and reinstalling the PM-10 inlet on the sample tube. Remove the filter cassette from the sampler, and discard the installed filter.

11.6.2. Five-Point Flow Calibration

Follow these steps to perform the five-point flow calibration:

1) **Return the sampler to the Main screen (Section 4.3).**
2) **The device must be in the Stop Operating Mode (Section 5.3) to perform a five-point flow calibration.**
3) **Carefully remove the PM-10 inlet from the sampler.**
4) **Install a filter cassette containing a 47 mm filter into the filter holding mechanism. This filter will be thrown away at the end of this flow calibration.**
5) **When in the Main screen, press <F5: Setup>, <F2: Calib> and then <F2: FlowCal> to display the Flow Calibration screen (Figure 11-6).**

Figure 11-6. Flow Calibration screen.



6) If you are using the Streamline Flow Transfer Standard (FTS) (Figure 11-5) to calibrate the flow of the Partisol-FRM Sampler, go to step 7. If you are not using the Streamline FTS to calibrate the flow of the Partisol-FRM Sampler, go to step 14.

7) Press the <ESC> key to display the Setup screen.

8) Press <F1: Edit>.

9) Press the arrow keys to scroll down to the "FTS CONST" field.

10) Enter the "m" constant from the FTS Calibration sheet.

11) Enter the "b" constant from the FTS Calibration sheet.

12) Press the <ENTER> key.

13) Press <F2:Calib> to return to the Calibration screen.

14) Attach the Streamline FTS or other flow metering device to the sample tube. Other flow meters may require the use of the flow audit adapter, which should be installed with its valve open.

15) Press <F2: Start> to begin the five-point flow calibration routine.

16) With the pump turned off, the sampler first computes the flow offset value before automatically starting the span calibration using five flow rates around the default sample flow rate of 16.7 l/min.

NOTE: Follow the instructions displayed by the sampler at the bottom of the Flow Calibration screen.

17) Determine the flow in actual l/min using the external flow meter. If you are using the Streamline FTS, go to step 18. If you are not using the Streamline FTS, go to step 20.

18) Press <F1:Edit>.

19) Enter the pressure (inches H_2O) in the "FTS Pres" field, then press the <ENTER> key. The sampler will now calculate the volumetric flow in l/min.

20) The unit will now operate at flow rates of 16.7, 17.5, 15.8, 18.3 and 15.0 l/min in succession. If you are using the Streamline FTS, go to step 21. If you are not using the Streamline FTS, go to step 22.

21) The sampler will automatically enter the calculated flow into the "ACT" field and compute "Span" value, which is the span offset for the mass flow controller. Go to step 23.

NOTE: If the instrument has been reset and you have recorded the "Offset" and "Span" values for the flow, you may enter these numbers directly when in the Edit Mode.

22) When in the Flow Calibration screen, wait for the "Current Flow" value to stabilize at each of these levels (16.7, 17.5, 15.8, 18.3 and 15.0 l/min). When "Current Flow" value stabilizes at each of these levels, press <F1: Edit>, move the cursor to the "Actual Flow" field, and enter the flow rate displayed by the external flow meter. Then press the <ENTER> key. The sampler uses this information to compute the proper flow span value. Go to step 23.

NOTE: If the instrument has been reset and you have recorded the "Offset" and "Span" values for the flow, you may enter these numbers directly when in the Edit Mode.

23) Return to the Main screen by pressing the <ESC> key three times.

24) Restore the sampling hardware to its original state by removing the flow metering hardware and reinstalling the PM-10 inlet on the sample tube. Remove the filter cassette from the sampler, and discard the installed filter.

Section 12: Resetting the Sampler

The Partisol-FRM Sampler provides a straightforward means of resetting its parameters to their default values. This section reviews the different types of reset capabilities available to the user.

✔ Use great care when performing the reset commands described in this section.

The Title screen (Figure 12-1) provides the user access to the unit's reset functions (Section 4.2). With this screen displayed on the instrument, the user can initiate reset functions by making use of the function keys in the manner described below. The user should exercise these capabilities with care, as information can be lost inadvertently if making an improper choice.

12.1. Resetting Operating Parameters

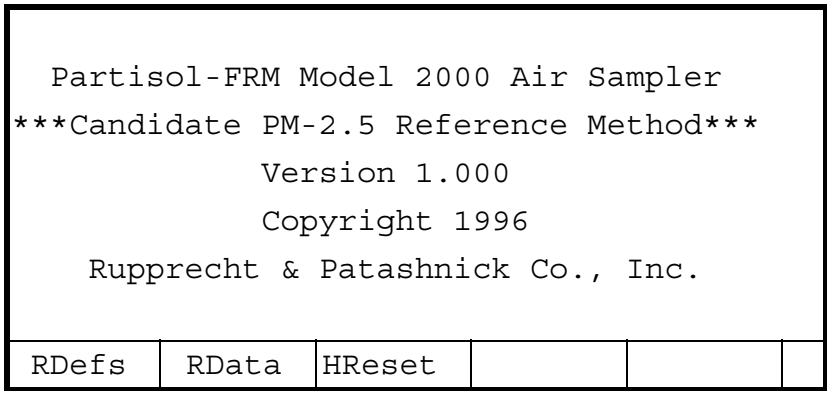
Pressing <F1: RDefs> with the Title screen displayed (Figure 12-1) causes the sampler to reset its operating parameters to their default settings. The system generates a single beep after the Title screen disappears to confirm that it has executed this command.

12.2. Resetting Data Storage

✔ A complete hardware reset requires <F3: HReset> to be pressed *twice*.

Pressing <F2: RData> with the Title screen displayed (Figure 12-1) causes the sampler to clear its filter data and interval data storage buffers (Section 7). The unit generates two beeps after the Title screen disappears to confirm that it has executed this command.

Figure 12-1. Title screen.



12.3. Performing a Hardware Reset

IMPORTANT: Record all calibration constants (offset and span) before resetting the sampler.

Pressing <F3: HReset> *twice* with the Title screen displayed (Figure 12-1) performs the function of both the <F1: RDefs> and <F2: RData> keys above, and additionally resets the system's EPROM. The sampler generates three beeps after the Title screen disappears to confirm that it has executed this command. *As a safeguard, the <F3: HReset> key must be pressed twice with the Title screen displayed to reset the hardware.*

NOTE: This command erases the calibration constants for temperature, pressure and flow calculations (Section 11), which must be reentered in the Calibration screen (Section 11) before operating the system again.

12.4. Resetting Password Protection

Pressing <F4> *twice* with the Title screen displayed sets the current password protection to "off." This can be useful if the user has misplaced the code used to turn on password protection, or if the user encounters any difficulties in turning password protection off. The sampler beeps four times upon successful deactivation of password protection.

Appendix A: Overview of Screens

This appendix contains all the instrument software screens displayed by the Partisol-FRM Sampler, along with the hierarchy of screens.

Figure A-1. Hierarchy of screens.

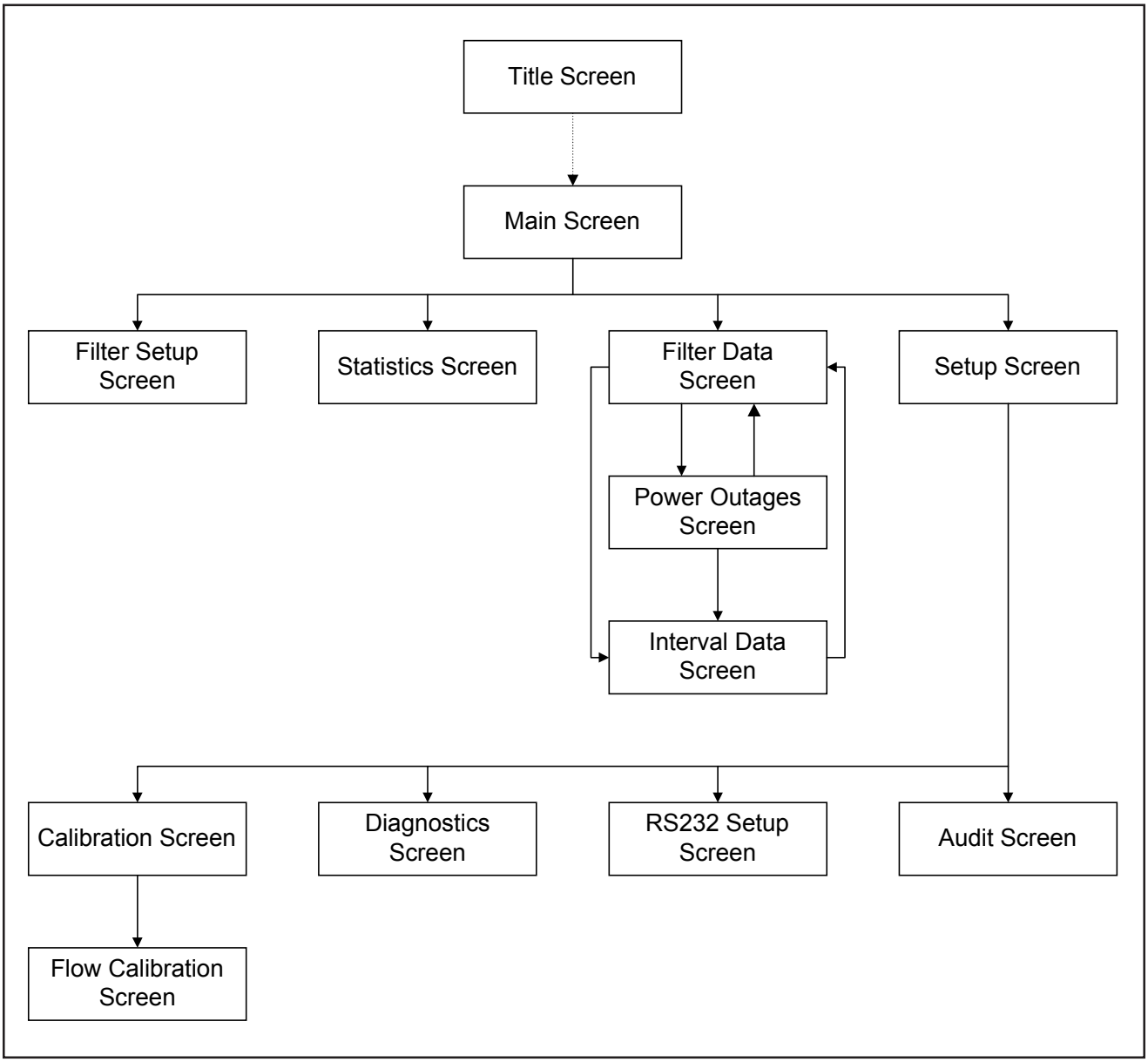


Figure A-2. Title screen.

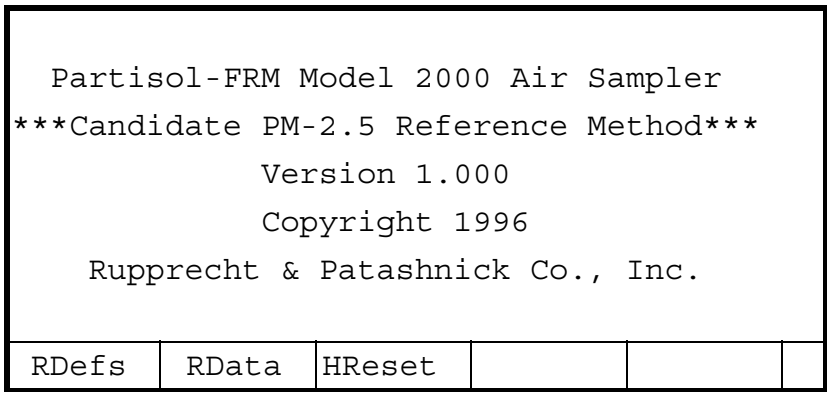


Figure A-3. Main screen.

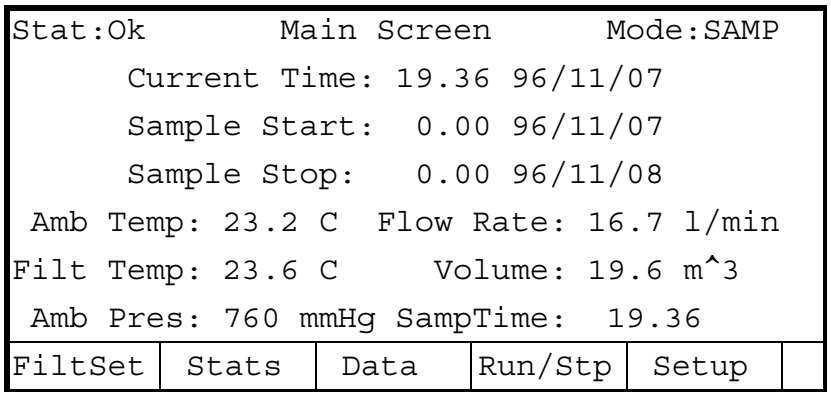


Figure A-4. Filter Setup screen.

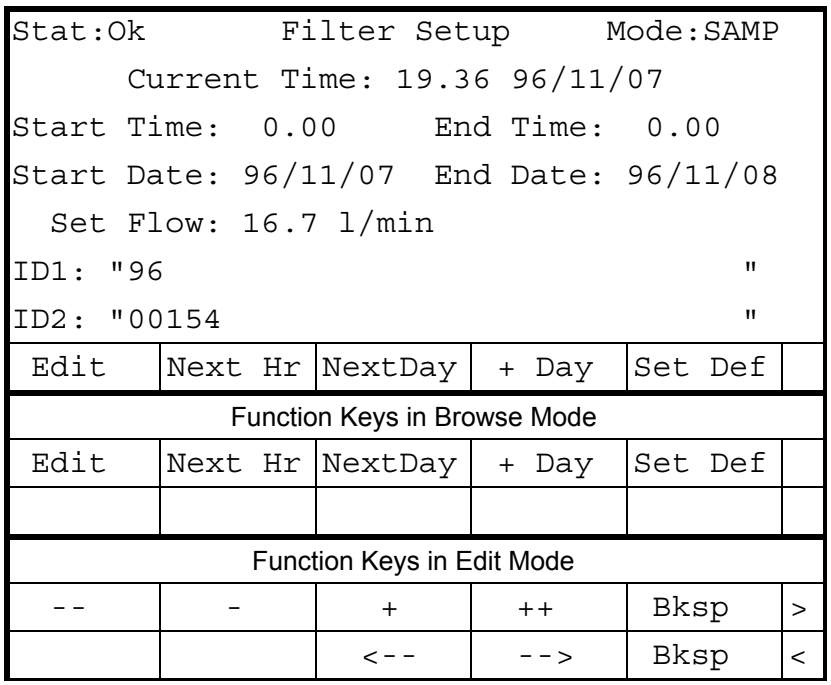


Figure A-5. Statistics screen.

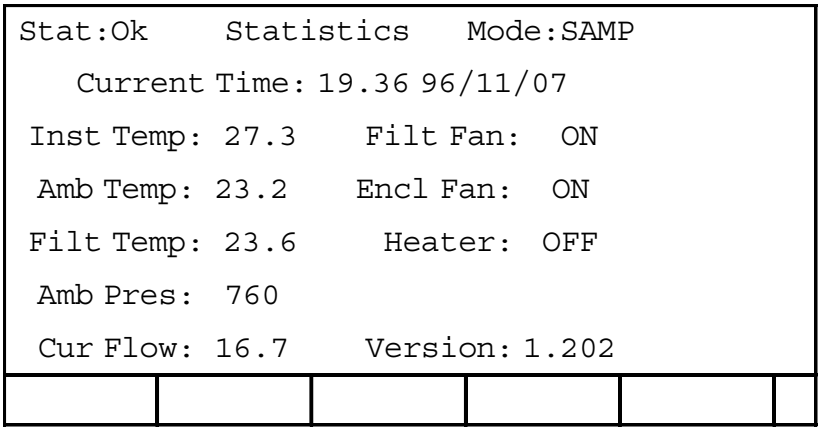

Stat:Ok Statistics Mode:SAMP
Current Time: 19.36 96/11/07
Inst Temp: 27.3 Filt Fan: ON
Amb Temp: 23.2 Encl Fan: ON
Filt Temp: 23.6 Heater: OFF
Amb Pres: 760
Cur Flow: 16.7 Version: 1.202

Figure A-6. Filter Data screen.

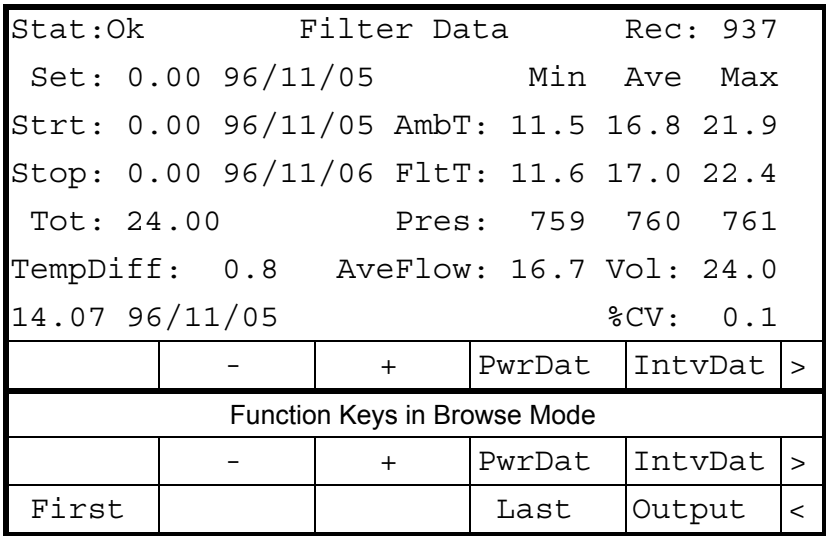

Stat:Ok Filter Data Rec: 937
Set: 0.00 96/11/05 Min Ave Max
Strt: 0.00 96/11/05 AmbT: 11.5 16.8 21.9
Stop: 0.00 96/11/06 FltT: 11.6 17.0 22.4
Tot: 24.00 Pres: 759 760 761
TempDiff: 0.8 AveFlow: 16.7 Vol: 24.0
14.07 96/11/05 %CV: 0.1
- + PwrDat IntvDat >
Function Keys in Browse Mode
- + PwrDat IntvDat >
First Last Output <

Figure A-7. Power Outages screen.

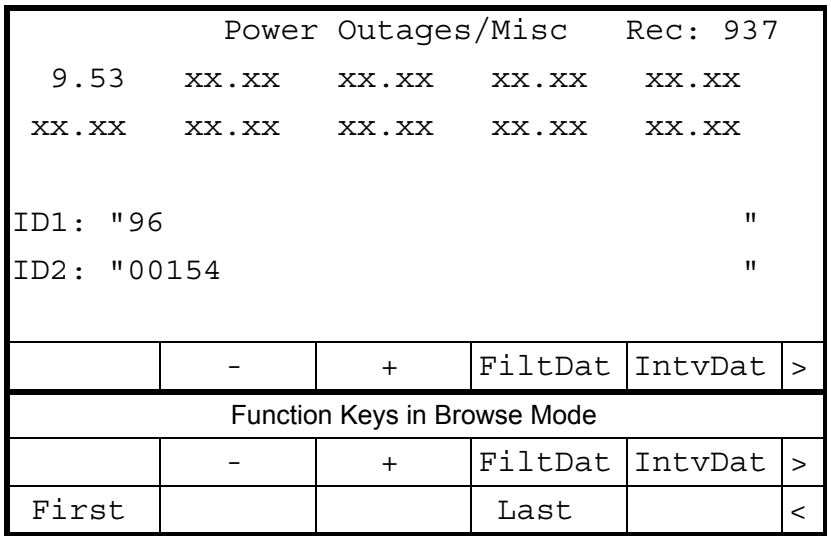

Power Outages/Misc Rec: 937
9.53 xx.xx xx.xx xx.xx xx.xx
xx.xx xx.xx xx.xx xx.xx xx.xx
ID1: "96 "
ID2: "00154 "
- + FiltDat IntvDat >
Function Keys in Browse Mode
- + FiltDat IntvDat >
First Last <

Figure A-8. Interval Data screen.

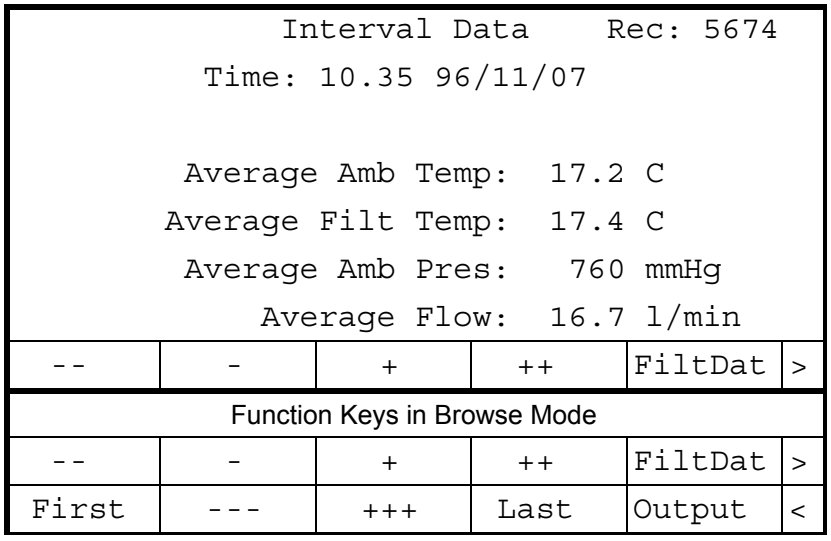

Interval Data Rec: 5674
Time: 10.35 96/11/07
Average Amb Temp: 17.2 C
Average Filt Temp: 17.4 C
Average Amb Pres: 760 mmHg
Average Flow: 16.7 l/min
-- - + ++ FiltDat >
Function Keys in Browse Mode
-- - + ++ FiltDat >
First --- +++ Last Output <

Figure A-9. Setup screen.

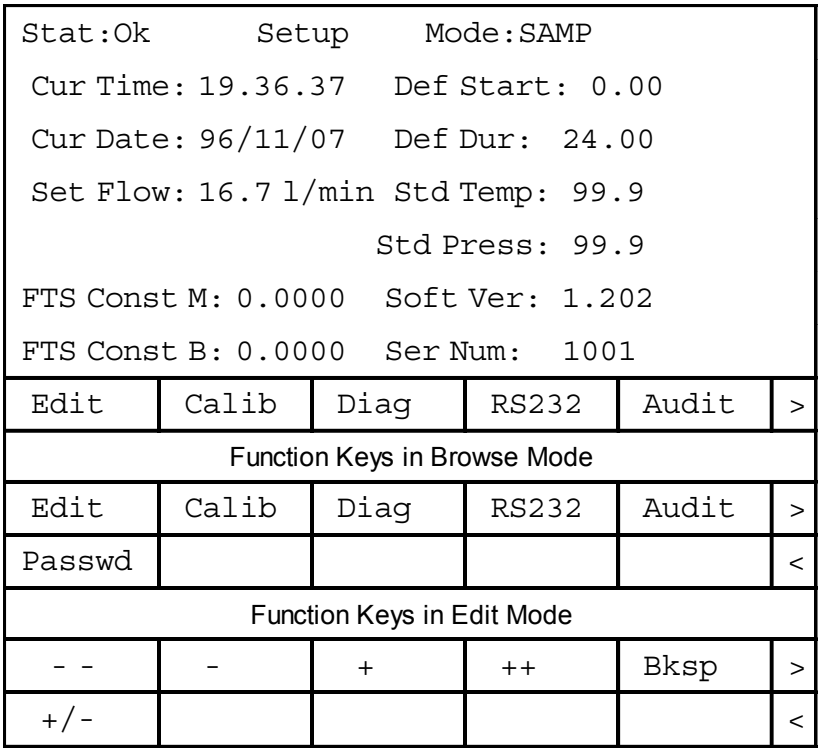


Figure A-10. Calibration screen.

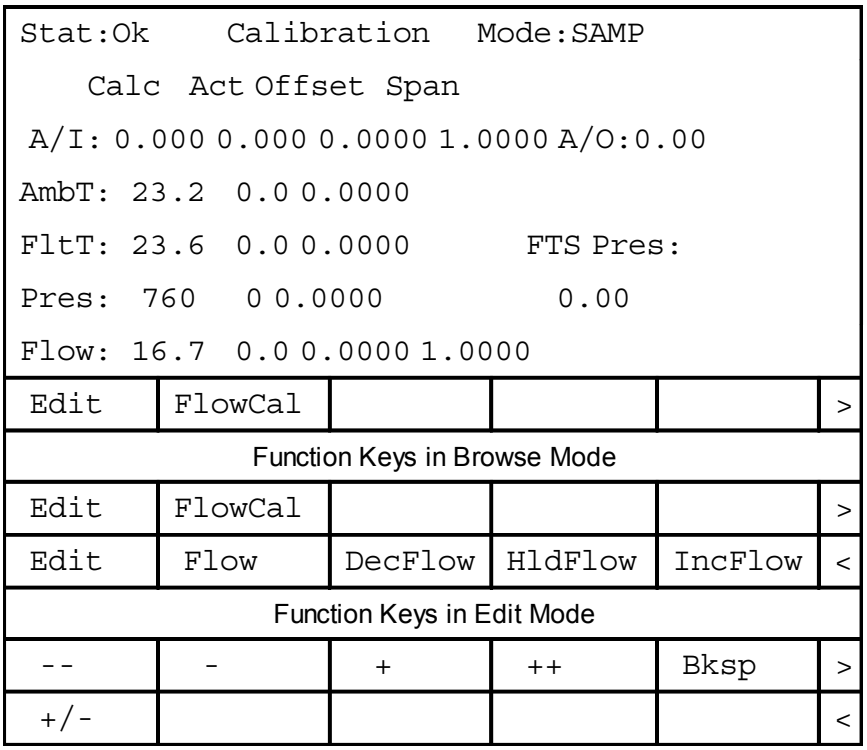


Figure A-11. Flow Calibration screen.

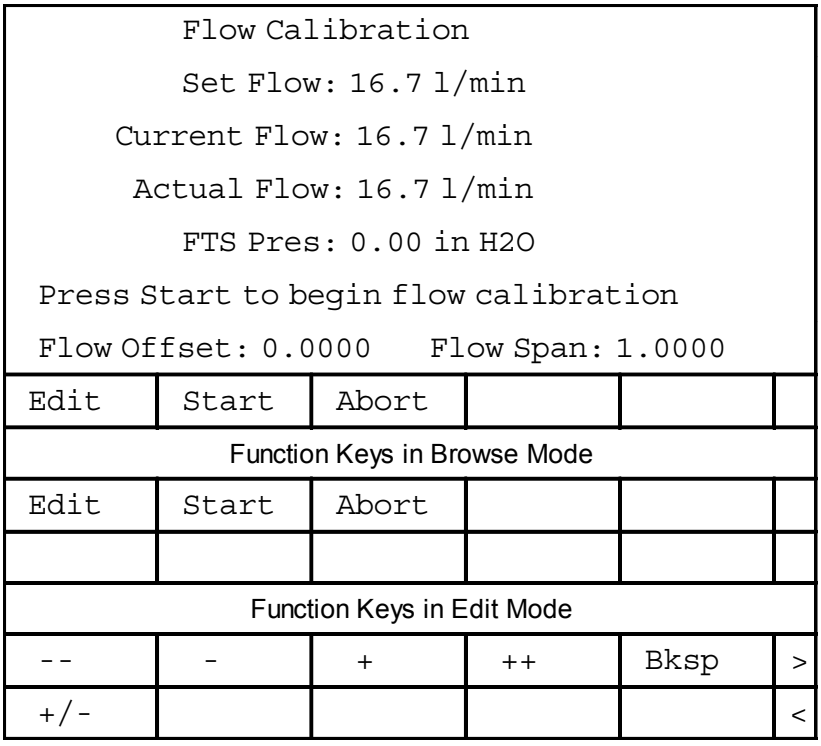


Figure A-12. Diagnostics screen.

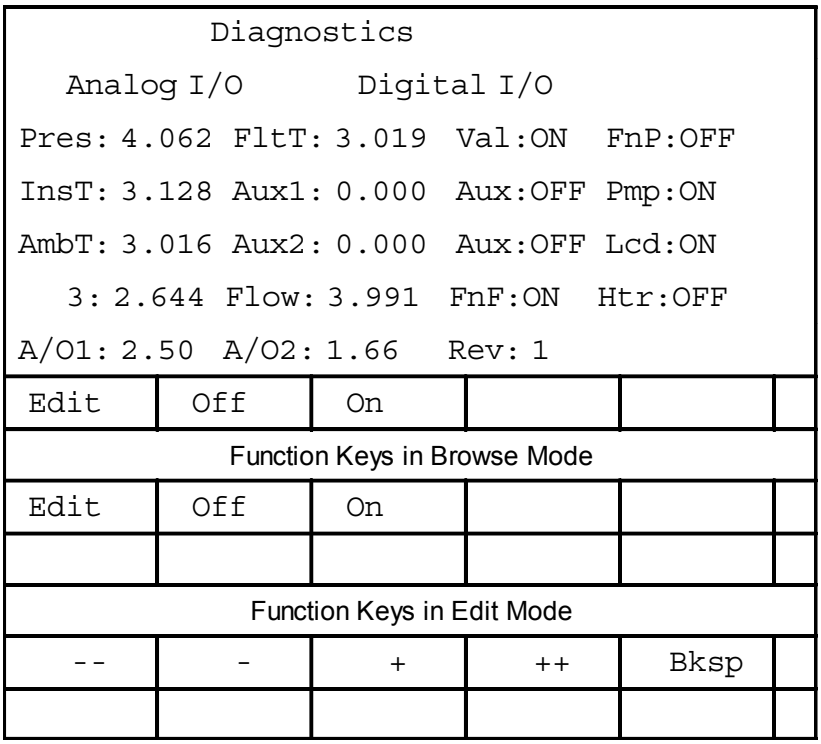


Figure A-13. RS232 Setup screen.

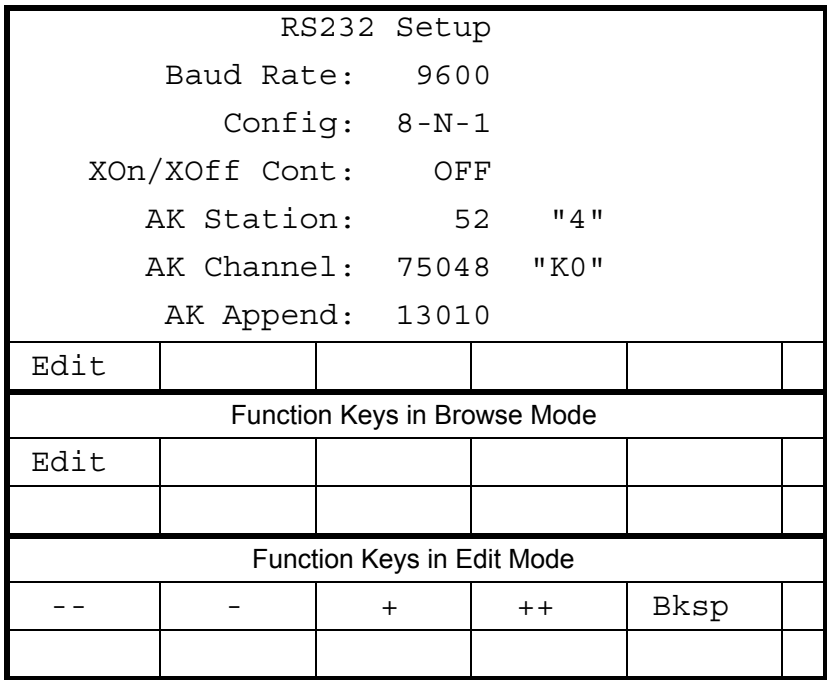
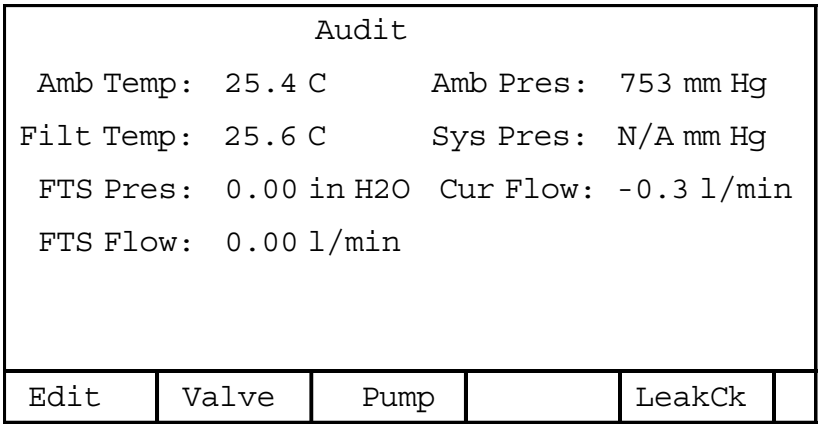


Figure A-14. Audit screen.



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Appendix B: Program Register Codes

This appendix contains a listing of the most important program register codes (PRCs) used in the software of the Partisol-FRM Sampler. The user would use these codes when using the hardware's two-way serial communication capability (Appendix D) to request the current value of variables, to change the value of certain system parameters, and to download data from the sampler's internal data logger.

MAIN PROGRAM REGISTER CODES

Code	Description	Units	Range	Default	Re-Init	Edit Modes
1	Software Version	N/A	N/A	N/A	N/A	not editable
2	Serial Number	N/A	0-1000000	N/A	N/A	anytime
3	Operating Mode	Code*	0-1	0	0	not editable
4	Status Code	Code*	0-511	0	0	not editable
7	Instrument Electronics Temperature	°C	N/A	N/A	N/A	not editable
8	Ambient Temperature	°C	N/A	N/A	N/A	not editable
9	Ambient Temperature (5-min average)	°C	N/A	N/A	N/A	not editable
10	Filter Temperature	°C	N/A	N/A	N/A	not editable
11	Filter Temperature (5-min average)	°C	N/A	N/A	N/A	not editable
12	Ambient Pressure	mmHg	N/A	N/A	N/A	not editable
13	Ambient Pressure (5-min average)	mmHg	N/A	N/A	N/A	not editable
14	Flow Rate Set Point	l/min	0 - 20	16.7	16.7	Stop
15	Current Flow Rate	l/min	N/A	N/A	N/A	not editable
16	Current Flow Rate (5-min average)	l/min	N/A	N/A	N/A	not editable
17	Volume Sampled	m^3	N/A	N/A	N/A	not editable
27	Default Start Time	sec	0 - 86400	0	0	Stop
28	Default Duration	sec	0 - 1.45E7	86400	86400	Stop
29	Start Time (sec since 70/1/1)	sec	0 - 2.147E9	0	0	Stop
30	Stop Time (sec since 70/1/1)	sec	0 - 2.147E9	0	0	Stop
38	Storage Download Type	Code*	1 - 2	0	0	anytime

* Codes are described later in this appendix.

Program register codes (PRCs) whose values are defined by codes are detailed below.

PRC 3: Operating Mode

0	STOP	Stop
1	WAIT	Wait
2	SAMP	Sampling
3	DONE	Done
5	ERR	Error

PRC 4: Status Code

0	Ok	No Status Conditions	0
&H1	F	Flow Rate	1
&H2	X	Flow Cutoff	2
&H4	S	Ambient Temperature	4
&H8	P	Ambient Pressure	8
&H10	T	Filter Temperature	16
&H20	I	Instrument Electronics Temperature	32
&H40	V	Power Outage (Voltage)	64
&H80	E	Elapsed Sampling Time	128
&H100	C	Coefficient of Variation	256

The current status code is the sum of all conditions that currently apply.

PRC 38: Storage Download Type

1	Filter Data
2	Interval Data

Appendix C: Hardware Connections

The Partisol-FRM Air Sampler contains two connectors for communicating analog and serial information with external devices:

User Output

This 4-pin connector, located on the back panel of the sampler, transmits an analog voltage level in accordance with the current flow rate and the existence of any status conditions (Section 8). The pin layout, as viewed from the end of the connecting cable, is shown in Figure C-1 and is defined below:

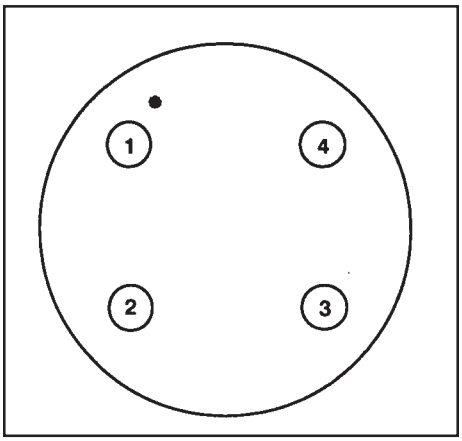

Figure C-1. Pin assignments of user output connector.

Pin 1	Cable shield
Pin 2	Ground
Pin 3	Analog voltage (0-5 VDC)
Pin 4	Not used

Each sampler is supplied with one cable connector for the 4-pin user output connector. Figure C-2 contains an assembly drawing that shows the internal construction of this connector.

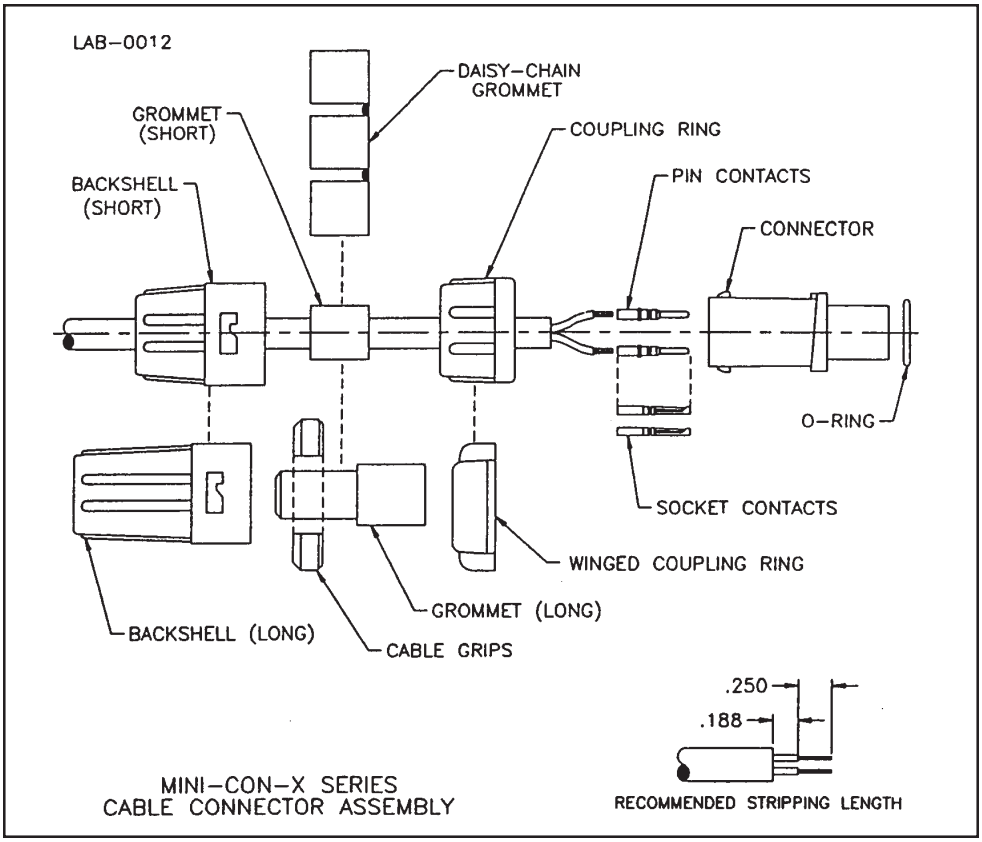

Figure C-2. Internal construction of 4-pin user output cable connector.

RS232

This 9-pin connector, located on the keypad panel of the sampler, allows for two-way serial communication between the sampler and an external device (Section 8). The nine pins in the RS232 connector are defined in the following manner (Figure C-3):

Pin 1	CD	Pin 6	DSR
Pin 2	TXD	Pin 7	RTS
Pin 3	RXD	Pin 8	Not used
Pin 4	Not used	Pin 9	Not used
Pin 5	GND		

The connection between the RS232 connector and a personal computer is accomplished using a straight 9-to-9 pin cable that R&P supplies as part of the sampler's basic configuration.

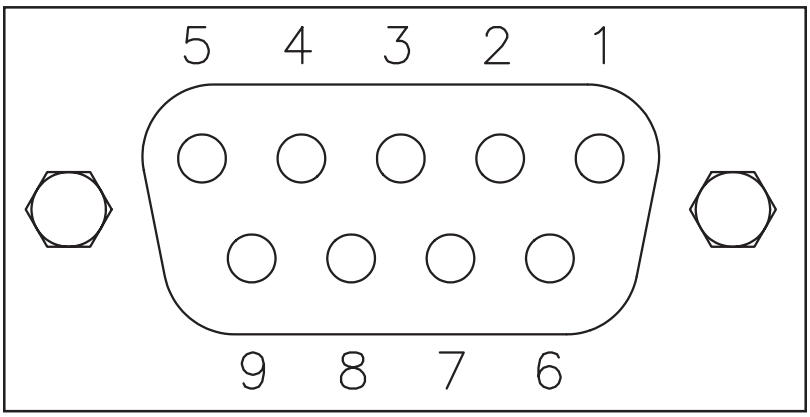

Figure C-3. 9-Pin RS232 connector.

Appendix D: Two-Way Serial Communication

The Partisol-FRM Sampler supports advanced two-way serial communication capabilities through its implementation of the German automobile industry's AK Protocol. Refer to Section 8 for a description of the RS232 Setup screen, which determines the hardware and software communication parameters of the sampler. Section 7 describes the fields downloaded when the user retrieves records from the filter data and interval data storage buffers using the ASTO command.

D.1. AK Protocol

The AK Protocol for serial communication not only allows the user to query the present value of system variables remotely, but also permits the user to change the values of system variables and download information from the sampler's internal data logger. The AKCOMM software provided with the sampler uses this protocol for two-way communication directly to a computer or through a modem. The following commands of the AK Protocol are presented in detail in the following pages:

AREG	Ask Register Command. This allows the user to query the Partisol-FRM Sampler for the current value of system variables (Program Register Codes, Appendix B).
EREG	Enter Register Command. This allows the user to assign a new value to any system variable. Great care must be exercised in using this command, as the value of variables should only be changed when the unit is in the appropriate operating mode.
ASTO	Ask Storage Command. This allows the user to download a specified number of records from the internal data logger, from the current position of the AK storage pointer. The initial location of this storage pointer is defined by the SSTO command. The values contained on each line of output are delimited by commas, and are described in detail in Section 7.
SSTO	Set Storage Command. This allows the user to change the location of the AK storage pointer in the internal data logger, and is used in conjunction with the ASTO command described above. The AK storage pointer is always located just following the last record transmitted through the RS-232 port via the AK Protocol. If the circular buffer overwrites

this location or if the ASTO or SSTO commands have not been used, the AK storage pointer resides at the oldest record in the internal database.

IMPORTANT NOTE: The Partisol-FRM Sampler contains two internal databases – one for filter data and the other for interval data (Section 7). When downloading stored information using the ASTO and SSTO commands of the AK Protocol, the user must specify which database is to be accessed by setting the value of Program Register Code 38 (Appendix B) to either "1" for Filter data or "2" for Interval data.

The following pages detail the format of the transmission and response messages of the commands listed above.

AK Protocol

Ask Register Command (AREG)

COM 2-WAY SETTINGS

AK Station	52	ASCII code for the 1-digit Station Number (for example "4": 052). The Station Number is always 1 digit in length.
AK Chan	75048	ASCII code representation of the 2-digit Channel Number (for example: "K0": 075, 048). The Channel Number is always 2 digits in length.
AK Append	13010	Optional: Up to 3 ASCII codes can be added to response from instrument. In this case, <CR> and <LF> (ASCII codes 013 and 010) are appended to the response. Enter 0 if nothing is to be appended.

Transmission to Instrument			Response from Instrument			
Byte	**Example**	**Description**	**B**	**No Err**	**Error**	**Description**
1	<STX>	ASCII code 002.	1	<STX>	<STX>	ASCII code 002.
2	4	1-digit Station Number, AK Station.	2	4	4	1-digit Station Number, AK Station.
3	A	Ask Register command. Enter the Program Register Code of the desired variable in bytes 21 to 23 below.	3	A	A	4-digit Ask Register command.
4	R		4	R	R	
5	E		5	E	E	
6	G		6	G	G	
7	<space>	Space.	7	<space>	<space>	Space.
8	K	2-digit Channel Number, as defined by AK Channel.	8	0	0	Number of current status conditions.
9	0		9	<space>	<space>	Space.
10	<space>	Space.	10	4	S	Program Register Code of the variable whose value is being requested. The PRC may be 1 to 3 characters long, and is not right-filled in the response.
11	4	Program Register Code of the variable whose value is being requested. The PRC may be up to 3 digits long. Do not right-fill if the PRC is less than 3 characters long.	11		E	
12			12		<ETX>	
13			13	<space>	<CR>	Space.
14	<ETX>	ASCII code 003.	14	3	<LF>	Current value of the variable referenced by the Ask Register command. This can vary in length.
15			15	2		
16			16	<ETX>		ASCII code 003.
17			17	<CR>		Up to 3 digits appended to the end of the response transmission, according to the entry for AK Append.
18			18	<LF>		
19			19			

AK Protocol

Enter Register Command (EREG)

COM 2-WAY SETTINGS

AK Station	52	ASCII code for the 1-digit Station Number (for example "4": 052). The Station Number is always 1 digit in length.
AK Chan	75048	ASCII code representation of the 2-digit Channel Number (for example: "K0": 075, 048). The Channel Number is always 2 digits in length.
AK Append	13010	Optional: Up to 3 ASCII codes can be added to response from instrument. In this case, <CR> and <LF> (ASCII codes 013 and 010) are appended to the response. Enter 0 if nothing is to be appended.

Transmission to Instrument			Response from Instrument			
Byte	**Example**	**Description**	**B**	**No Err**	**Error**	**Description**
1	<STX>	ASCII code 002.	1	<STX>	<STX>	ASCII code 002.
2	4	1-digit Station Number, AK Station.	2	4	4	1-digit Station Number, AK Station.
3	E	Enter Register command. Enter the Program Register Code in bytes 21 to 23 below, and the new value of the variable in bytes 15 and following.	3	E	E	4-digit Enter Register command.
4	R		4	R	R	
5	E		5	E	E	
6	G		6	G	G	
7	<space>	Space.	7	<space>	<space>	Space.
8	K	2-digit Channel Number, as defined by AK Channel.	8	0	0	Number of current status conditions.
9	0		9	<space>	<space>	Space.
10	<space>	Space.	10	1	S	Program Register Code of the variable whose value was entered. The PRC may be 1 to 3 characters long, and is not right-filled in the response.
11	1	Program Register Code of the variable whose value is being entered. The PRC may be up to 3 digits long. Do not right-fill if the PRC is less than 3 characters long.	11	4	E	
12	4		12		<ETX>	
13			13	<ETX>	<CR>	ASCII code 003
14	<space>	Space.	14	<CR>	<LF>	Up to 3 digits appended to the end of the response transmission, according to the entry for AK Append.
15	1	New value to be entered for variable referenced by Program Register Code in bytes 11 to 13 above. NOTE: The value entered may be of varying length.	15	<LF>		
16	6		16			
17	.		17			
18	7		18			
19	<ETX>	ASCII code 003.	19			

AK Protocol

Ask Storage Command (ASTO)

COM 2-WAY SETTINGS

AK Station	52	ASCII code for the 1-digit Station Number (for example "4": 052). The Station Number is always 1 digit in length.
AK Chan	75048	ASCII code representation of the 2-digit Channel Number (for example: "K0": 075, 048). The Channel Number is always 2 digits in length.
AK Append	13010	Optional: Up to 3 ASCII codes can be added to response from instrument. In this case, <CR> and <LF> (ASCII codes 013 and 010) are appended to the response. Enter 0 if nothing is to be appended.

Transmission to Instrument

Byte	Example	Description
1	<STX>	ASCII code 002.
2	4	1-digit Station Number, RS-Para 1.
3	A	Ask Storage command. Enter the number of records to be downloaded from storage in bytes 11 to 13 below.
4	S	
5	T	
6	O	
7	<space>	Space.
8	K	2-digit Channel Number, as defined by RS-Para 2.
9	0	
10	<space>	Space.
11	5	The number of records to be downloaded from the instrument's storage. Downloading begins at the storage marker, which can be set using the SSTO command.
12	0	
13		
14	<ETX>	ASCII code 003.

SET CURRENT DATA STORAGE BUFFER

1 in PRC 38 Filter Data
2 in PRC 38 Interval Data

Response from Instrument

B	No Err	Error	Description
1	<STX>	<STX>	ASCII code 002.
2	4	4	1-digit Station Number, RS-Para 1.
3	A	A	4-digit Ask Storage command.
4	S	S	
5	T	T	
6	O	O	
7	<space>	<space>	Space.
8	0	0	Number of current status conditions.
9	<space>	<space>	Space.
10	3	S	Records to be downloaded from storage. This can be smaller than requested number due to end of file. Storage marker moved to after last record transmitted. Not right-filled.
11	1	E	
12		<ETX>	
13	<ETX>	<CR>	ASCII code 003.
14	<CR>	<LF>	Up to 3 digits appended to the end of the response transmission, according to the entry for RS-Para 3.
15	<LF>		
16			

The instrument then transmits the number of storage records shown in response bytes 10 to 12 above. Each record is followed by <CR><LF>. Refer to Section 7 for the format of the downloaded data records.

AK Protocol

Set Storage Marker Command (SSTO)

COM 2-WAY SETTINGS

AK Station	52	ASCII code for the 1-digit Station Number (for example "4": 052). The Station Number is always 1 digit in length.
AK Chan	75048	ASCII code representation of the 2-digit Channel Number (for example: "K0": 075, 048). The Channel Number is always 2 digits in length.
AK Append	13010	Optional: Up to 3 ASCII codes can be added to response from instrument. In this case, <CR> and <LF> (ASCII codes 013 and 010) are appended to the response. Enter 0 if nothing is to be appended.

Transmission to Instrument			Response from Instrument			
Byte	**Example**	**Description**	**B**	**No Err**	**Error**	**Description**
1	<STX>	ASCII code 002.	1	<STX>	<STX>	ASCII code 002.
2	4	1-digit Station Number, AK Station.	2	4	4	1-digit Station Number, AK Station.
3	S	4-digit Set Storage Marker command.	3	S	S	4-digit Set Storage Marker command.
4	S		4	S	S	
5	T		5	T	T	
6	O		6	O	O	
7	<space>	Space.	7	<space>	<space>	Space.
8	K	2-digit Channel Number, as defined by AK Channel.	8	0	0	Number of current status conditions.
9	0		9	<ETX>	<space>	ASCII code 003.
10	<space>	Space.	10	<CR>	S	Up to 3 digits appended to the end of the response transmission, according to the entry for AK Append.
11	B	New location of the Storage Marker. B: move to beginning of storage buffer, E: move to end of storage buffer. Enter positive numbers such as 250 to move forward by n records, and negative numbers such as -1000 to move backwards by n records. Do not right-fill.	11	<LF>	E	
12			12		<ETX>	
13			13		<CR>	
14			14		<LF>	
15			15			
16	<ETX>	ASCII code 003.	16			
17			17			
18			18			
19			19			

AK Protocol

Response if Command Addressed to Instrument is Unrecognizable

COM 2-WAY SETTINGS		
AK Station	52	ASCII code for the 1-digit Station Number (for example "4": 052). The Station Number is always 1 digit in length.
AK Chan	75048	ASCII code representation of the 2-digit Channel Number (for example: "K0": 075, 048). The Channel Number is always 2 digits in length.
AK Append	13010	Optional: Up to 3 ASCII codes can be added to response from instrument. In this case, <CR> and <LF> (ASCII codes 013 and 010) are appended to the response. Enter 0 if nothing is to be appended.

Transmission to Instrument			Response from Instrument			
Byte	**Example**	**Description**	**B**	**No Err**	**Error**	**Description**
1			1		<STX>	ASCII code 002.
2			2		4	1-digit Station Number, AK Station.
3			3		?	Question marks inserted in place of unrecognized command.
4			4		?	
5			5		?	
6			6		?	
7			7		<space>	Space.
8			8		0	Number of current status conditions.
9			9		<space>	Space.
10			10		S	Syntax error.
11			11		E	
12			12		<ETX>	ASCII code 003.
13			13		<CR>	Up to 3 digits appended to the end of the response transmission, according to the entry for AK Append.
14			14		<LF>	
15			15			
16			16			
17			17			
18			18			
19			19			

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Appendix E: Installing New System Software

The software that operates the Partisol-FRM Sampler is stored on a hardware component known as an "electrically erasable, programmable read-only memory" (EPROM) chip. Software upgrade kits, which include the EPROM and installation instructions, can be ordered from R&P with the following part number:

Partisol-FRM EPROM upgrade kit	59-005146-0FRM

Other equipment required to install the EPROM include a ground strap (R&P part # 13-002601) and EPROM extraction tool (R&P part #12-002579), which also can be ordered from R&P.

Follow these steps to install new system software:

IMPORTANT: Be sure to download any important data contained in the internal data logger before executing these steps.

1) **Attach one end of the ground strap around your wrist. Attach the other end of the strap to a ground source such as the Partisol enclosure.**
2) **Record the values in the "Offset" and "Span" columns of the Calibration screen (Section 10).**
3) **With the system in its Stop Operating Mode, turn off the hub unit at the power switch next to the keypad, and unplug the sampler.**
4) **Open the electrical compartment behind the keypad.**
5) **Locate the EPROM at position "U3" on the computer board that is mounted on the back wall of the electrical compartment (Figures E-1 and E-2). The chip will have a sticker attached to it stating its current software revision number.**
6) **Using the chip extraction tool, grip the top and bottom of the old EPROM and pull outward. Be sure to pull the EPROM out *straight*. Do not twist or turn the chip while extracting it from the board.**
7) **Return the old EPROM chip to R&P with the appropriate return number indicated by the Service Department.**
8) **Note the silk-screened outline of the EPROM on the computer board in the mounting location. Note the position of the notch.**
9) **Examine the new EPROM and locate its notch.**
10) **Line up the notch on the EPROM and the silk-screened notch on the board. The notch should face *downward.* Press the new EPROM into this position.**

Figure E-1. Location of the EPROM (A) on the computer board.

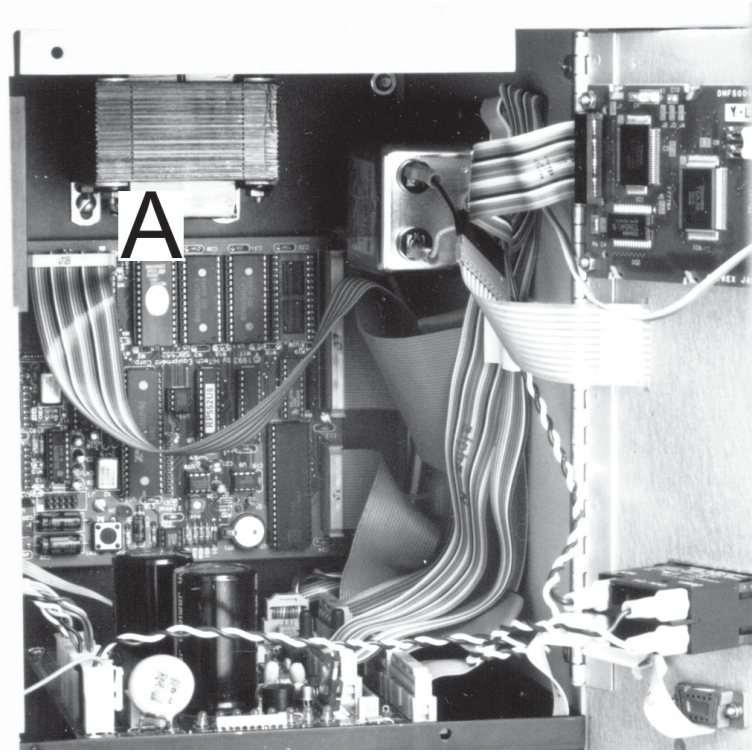
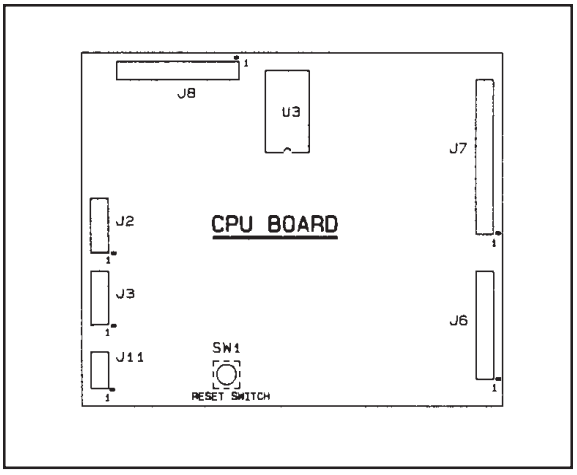


Figure E-2. Drawing of computer board, displaying the location of U3.



11) Return power to the hardware.

12) Press SW1 on the CPU board and then <F3> *twice* when the Title screen appears to reset the Partisol Sampler, including its internal data logger.

13) Enter the values recorded in step 2 above in the Calibration screen (Section 10).

14) Enter the appropriate system parameters in the Setup screen (Section 4).

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Appendix F: Consumables and Parts

This section contains the parts and accessories for the Partisol-FRM Sampler.

F.1. Consumables

Teflon filters, 2.0 µm pore size, box of 50	10-002322-0050
Single filter carrier	55-004847
Dual-filter transport container	20-004996
Partisol-FRM filter cassette for 47 mm filters	59-004648-0001
5 Partisol-FRM filter cassettes for 47 mm filters	59-004648-0005
10 Partisol-FRM filter cassettes for 47 mm filters	59-004648-0010
Filter cassette screens, package of 5	30-005147-0005
Solid filter leak check/separator disk	36-004768
Tweezers	30-002566
Filter cassette separator tool	38-004892

Inlets and Accessories

WINS PM-2.5 impactor	57-004006
Impactor assembly	55-004289
WINS O-ring, 2 3/8" ID x 2 1/2 OD x 1/16", BUNA	22-0002853-3036
Box of 25 glass fiber filters, 37 mm	32-004294
Bottle of WINS impactor oil, 30 ml	59-004292
Bottle of WINS impactor oil, 100 ml	59-004792-0100
PM-10 inlet	57-004742
PM-10 inlet O-ring 1 1/4" ID x 1 3/8" OD x 1/16", BUNA	22-00485-1026
PM-10 inlet O-ring 2 3/8" ID x 2 1/2" OD x 1/16", BUNA	22-000485-1036

Aside from the 47 mm collection filters and 37 mm WINS impactor filters used in the Partisol-FRM Sampler, the only regular consumable item in the hardware is the large in-line filter located in the pump compartment. This item should be exchanged every six months.

Large in-line filter	32-002643

The batteries on the computer board at the back of the electronics compartment must be exchanged as needed. The computer board uses a 25 mm diameter round battery (Panasonic CR2330) and a socket battery at location U4 (Dallas Semiconductor DS1213C).

Round battery for computer board	06-002545
Battery for socket at U4	06-002565

Perform the following procedures to check these batteries:

1. Measure the voltage across the ground (“GND”) test point in the center of the interface board and the top surface of the round battery on the computer board. This voltage should be at least 2.5 VDC.
2. Measure the voltage across pins 14 and 28 on U4 for part number 06-002565. This voltage should be at least 2.5 VDC.

F.2. PARTS

Basic Hardware	
Dome connector for sample tube	13-004300
Viton upper cassette seal	22-002680
Lower cassette seal	22-004276
Power switch	04-002649
Cooling fan	10-002251
Foam fan covers	10-003092
Liquid Crystal Display (LCD)	10-002254
Rubber foot	33-002262
Sample tube	36-004293
Power line filter	02-002400
Transformer	03-002402
Interface board	50-003709
Computer board	50-002407
Standard Partisol pump, 120 VAC	10-002418
Standard Partisol pump, 240 VAC	10-002452
Partisol pump rebuild kit (2 required)	59-002642
Solenoid valve	59-002456
Flow control assembly	55-002663
Streamline FTS	57-004506
Streamline FTS with manometer	57-004506-001
Flow audit adapter	57-000618
Accumulator assembly	55-002555
Ambient temperature sensor package	59-002640
Latch for filter exchange mechanism	33-004221
Large rain hood	38-004011
Gasket for large rain hood	33-004201
Small rain hood	36-003817
Gasket for small rain hood	33-002371
AKCOMM software diskette	41-004001
Connectors and Cables	
9-to-9 pin RS-232 cable	07-000587
9-pin “D” connector	06-000590-0009
Shell for 9-pin “D” connector	06-000592-0009
9-to-25 pin serial adapter	51-001079
4-pin cable connector	06-002453
Analog input calibration cable	51-004282

Manuals	
Partisol-FRM Operating Manual	42-004298
Partisol-FRM Service Manual	42-004278
Partisol-FRM Quick Start Guide	42-004299
Other Products	
Support stand	57-004644
Partisol-FRM EPROM software revision kit	59-004302
Insulating jacket	10-004359

Appendix G: Filter Log

This appendix contains a filter log to keep track of all important readings associated with each exposed filter. R&P encourages users to make photocopies of the form or to use a similar format.

Filter Log

R&P Partisol-FRM Model 2000 PM-2.5 Air Sampler

Filter Number	Initial Conditioning	Initial Weighing		Filter Exposure		Post-Collection Conditioning	Post-Collection Weighing		DW	Concentration
	Conditions	Weights	Conditions	Exposure Period	Exposure Stats	Conditions	Weights	Conditions	W(F)-W(I)	DWx10^6/Volume
	RH: Temp: Date: Time:	W1: W2: W3: W(I):	RH: Temp: Date: Time:		Val Time: Tot Time: Volume:	RH: Temp: Date: Time:	W1: W2: W3: W(F):	RH: Temp: Date: Time:		
	RH: Temp: Date: Time:	W1: W2: W3: W(I):	RH: Temp: Date: Time:		Val Time: Tot Time: Volume:	RH: Temp: Date: Time:	W1: W2: W3: W(F):	RH: Temp: Date: Time:		
	RH: Temp: Date: Time:	W1: W2: W3: W(I):	RH: Temp: Date: Time:		Val Time: Tot Time: Volume:	RH: Temp: Date: Time:	W1: W2: W3: W(F):	RH: Temp: Date: Time:		
	RH: Temp: Date: Time:	W1: W2: W3: W(I):	RH: Temp: Date: Time:		Val Time: Tot Time: Volume:	RH: Temp: Date: Time:	W1: W2: W3: W(F):	RH: Temp: Date: Time:		
	RH: Temp: Date: Time:	W1: W2: W3: W(I):	RH: Temp: Date: Time:		Val Time: Tot Time: Volume:	RH: Temp: Date: Time:	W1: W2: W3: W(F):	RH: Temp: Date: Time:		
	RH: Temp: Date: Time:	W1: W2: W3: W(I):	RH: Temp: Date: Time:		Val Time: Tot Time: Volume:	RH: Temp: Date: Time:	W1: W2: W3: W(F):	RH: Temp: Date: Time:		
	RH: Temp: Date: Time:	W1: W2: W3: W(I):	RH: Temp: Date: Time:		Val Time: Tot Time: Volume:	RH: Temp: Date: Time:	W1: W2: W3: W(F):	RH: Temp: Date: Time:		
	RH: Temp: Date: Time:	W1: W2: W3: W(I):	RH: Temp: Date: Time:		Val Time: Tot Time: Volume:	RH: Temp: Date: Time:	W1: W2: W3: W(F):	RH: Temp: Date: Time:		
	RH: Temp: Date: Time:	W1: W2: W3: W(I):	RH: Temp: Date: Time:		Val Time: Tot Time: Volume:	RH: Temp: Date: Time:	W1: W2: W3: W(F):	RH: Temp: Date: Time:		

Appendix H: Inlet Maintenance

This appendix contains the maintenance procedures for the PM-10 inlet and the PM-2.5 WINS impactor used in the Partisol-FRM Sampler.

H.1. Maintenance of PM-10 Inlet

Recommended Supplies for Maintenance

- Alcohol or ammonia-based, general-purpose cleaner
- Cotton swabs
- Small soft-bristle brush
- Paper towels
- Distilled water
- Silicone-based, stopcock grease.

Recommended Tools for Maintenance

- Small Philips-blade screwdriver
- Small crescent wrench
- Pocket knife.

Maintenance Frequency

R&P recommends that the user remove and clean the PM-10 inlet, and check its O-ring after every 14 days of inlet usage.

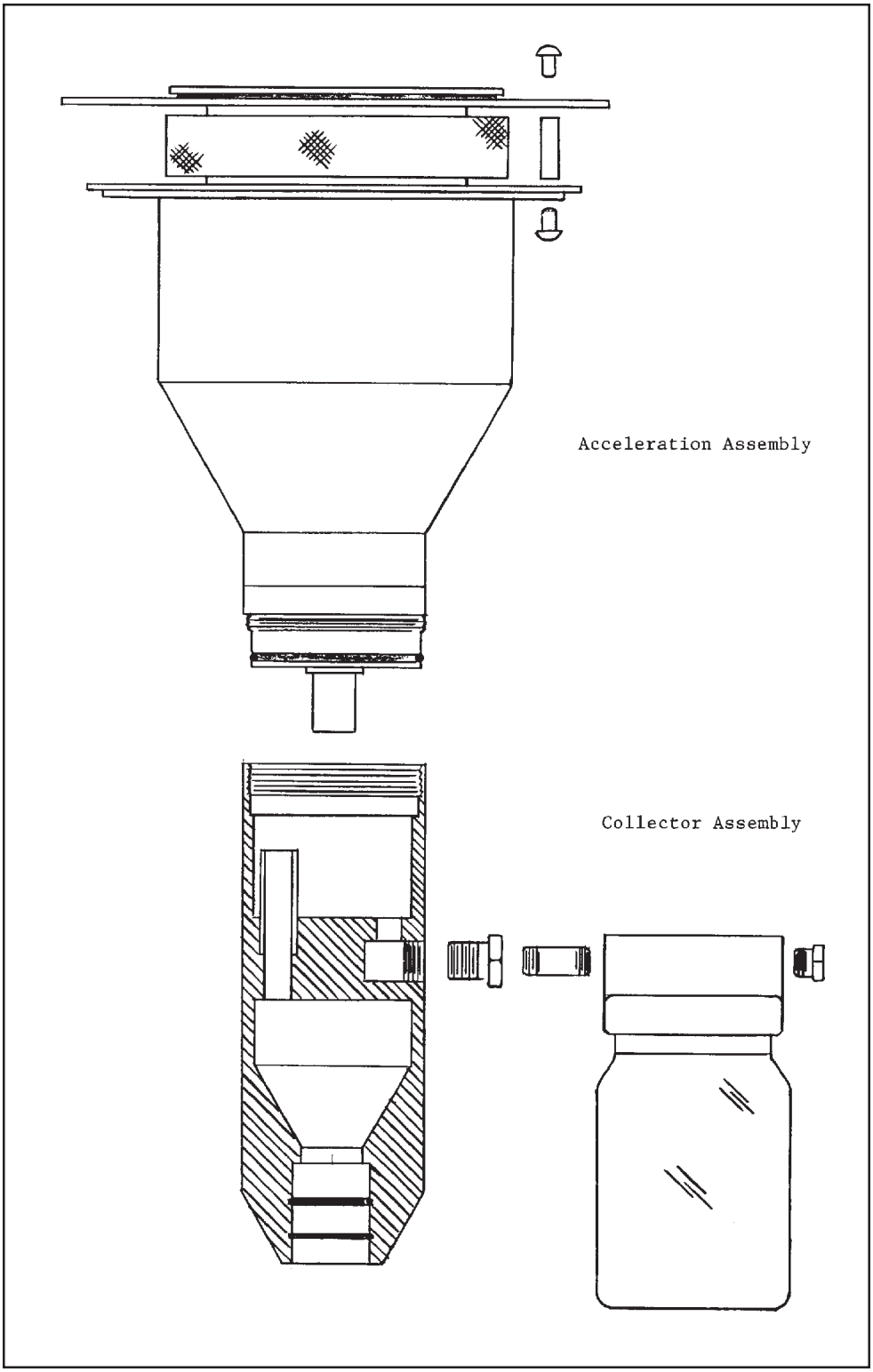
H.1.1. Removing the PM-10 Inlet

Follow these steps to remove the PM-10 inlet from the sampler:

1) Lift the PM-10 inlet upward off the aluminum sample inlet tube.

2) Disassemble the upper and lower inlet halves by unscrewing counterclockwise the top acceleration assembly from the lower collector assembly (Figure H-1).

Figure H-1. Main sections of the PM-10 inlet.



H.1.2. Maintaining the Top Acceleration Assembly

Follow these steps to maintain the top acceleration assembly:

1) **Mark the top plate deflector cone and lower plate with a pencil scribe to indicate proper orientation for easier reassembly after cleaning and maintenance.**
2) **Using a Philips-blade screwdriver, remove the four pan head screws from the top of the top plate, and lift the top plate off the four threaded spacer standoffs and set aside.**
3) **Inspect the insect screen for contamination and clean by lifting the screen off the lower plate rain deflector and brush or rinse with water until clean. Dry and reinstall.**
4) **Using a general-purpose cleaner and paper towel, clean the top plate deflector cone and internal wall surface of the acceleration assembly.**

   NOTE: Be sure that after cleaning the acceleration nozzle is clean. If not, use a cotton swab and cleaner to remove contamination.

5) **Inspect the large diameter impactor nozzle O-ring for wear. Replace, if necessary, or using a light coating of silicone grease, apply a thin film on the O-ring itself, and likewise a light coating on the aluminum threads of the acceleration assembly.**
6) **After reinstalling the insect screen, align the top plate markings with the lower plate markings. The four holes in the top plate should align with the four spacer standoffs. Insert and securely tighten the four pan-head screws.**

H.1.3. Maintaining the Lower Collector Assembly

Follow these steps to maintain the lower collector assembly:

NOTE: Most of the contamination in the inlet generally will be found on the collector plate.

1) **Using a general-purpose cleaner with a paper towel, clean the collector assembly walls and three vent tubes. You may need to use a cotton swab to clean the vent tubes.**
2) **Clean the bottom side of the collector assembly.**
3) **Using a cotton swab, clean the weep hole in the collector plate where the moisture runs into the moisture trap.**
4) **Remove the rain jar and clean it.**
5) **Inspect the brass nipple fitting on the rain jar to ensure tightness and non-blockage.**
6) **Place a light coating of silicone grease on the cork gasket inside the cap of the rain jar.**
7) **Reinstall the rain jar onto the lower collector assembly.**
8) **Inspect the two inlet-to-inlet tube sealing O-rings for wear. Replace, if necessary.**
9) **Plase a light coating of silicone grease on the two inlet-to-inlet tube sealing O-rings to ensure that a proper seal is made when the PM-10 inlet is reinstalled on the sample inlet tube.**
10) **Clean the threads on the top and bottom inlet assemblies.**
11) **Reassemble the top and bottom inlet assemblies until the threads tighten. Hand-tighten only.**
12) **Place the PM-10 inlet back on top of the sample inlet tube. Take care not to damage the internal O-rings.**

NOTE: For further information or parts, please contact R&P, its distributors or representatives.

H.2. Maintenance of the PM-2.5 WINS Impactor

The procedures below describe the removal, cleaning, and reinstallation of the PM-2.5 WINS impactor.

H.2.1. Removing the WINS Impactor

Follow these steps to remove the WINS impactor from the sampler:

1) **Open the door of the Partisol-FRM Sampler.**
2) **Open the filter exchange mechanism by pulling on its handle (Figures H-2 and H-3).**

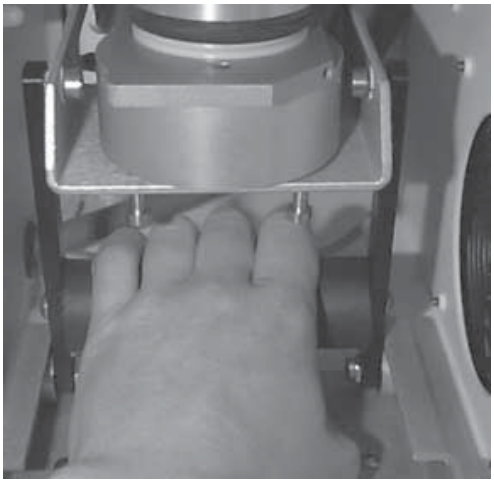


Figure H-2. Grasping the handle of the filter exchange mechanism.

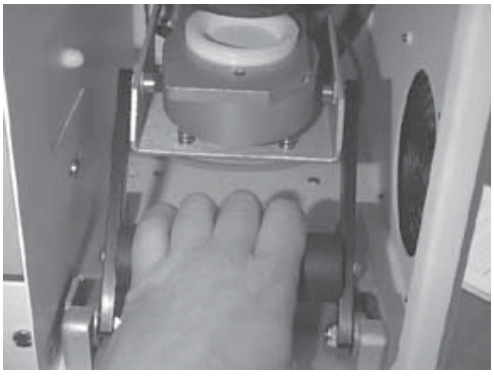
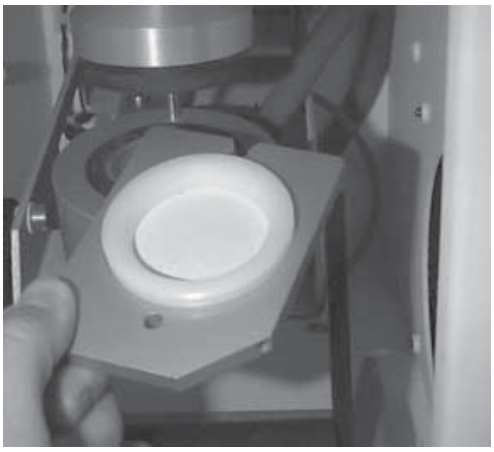


Figure H-3. Pulling backward on the handle of the filter exchange mechanism.

3) Release the handle and allow it to drop down.

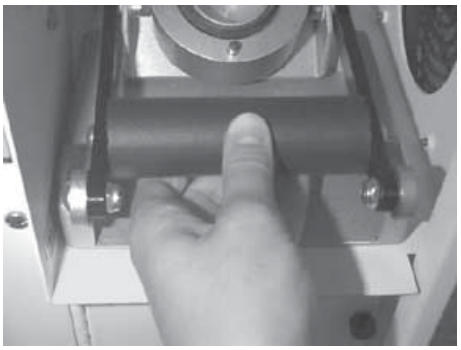
4) Remove the filter cassette carrier from the filter platform (Figure H-4).

Figure H-4. Removing the filter cassette carrier from the filter platform.



5) Push the filter exchange mechanism toward the back slightly, and lift the rollers through the slots in the left-hand and right-hand guides (Figure H-5).

Figure H-5. Lifting the rollers through the guide slots.



6) Allow the filter platform to settle downward, and remove the WINS impactor and adapter.

7) Separate the adapter from the WINS impactor (Figure H-6).

Figure H-6. Adapter (left) and WINS impactor (right).

H.2.2. Cleaning the WINS Impactor

Follow these steps to clean the WINS impactor:

1) **Unscrew the middle section of the WINS impactor to remove its top piece from its bottom piece. This will expose the impactor assembly.**
2) **Remove the impactor assembly from the bottom section of the WINS impactor (Figure H-7).**

Figure H-7. Upper (left) and lower (right) sections of the impactor assembly .

3) **Using a dry paper towel, wipe off the inside surfaces of the WINS impactor. You may use a general purpose cleaner, if necessary.**

4) **Inspect all O-rings in the top and bottom sections of the WINS impactor for damage and replace, if necessary.**

5) **Place a thin coating of O-ring lubricant onto the O-rings, if necessary.**

6) **Remove the top of the impactor assembly by lifting it upward.**

7) **Remove any filter that was previously installed.**

8) **Clean the top and bottom of the impactor assembly using a dry paper towel. You may use a general purpose cleaner, if necessary.**

9) **Inspect the O-ring in the top section of the impactor assembly for damage and replace, if necessary.**

10) **Place a thin coating of O-ring lubricant onto the O-ring, if necessary.**

11) **Place a new 37 mm borosilicate glass fiber filter onto the bottom of the impactor assembly (Figure H-8).**

Figure H-8. Installing a 37 mm glass filter into the impactor assembly.

12) **Place 42 to 44 drops of impactor oil onto the filter.**

13) **Place the top of the impactor assembly onto the bottom of the assembly.**

14) Place the impactor assembly into the bottom section of the WINS impactor.

15) Screw the top of the WINS impactor onto the bottom section. Ensure that the WINS impactor remains in the upright orientation so that the oil in the impactor assembly does not spill.

16) Multiple WINS impactors can be prepared in this manner at one time and kept for later use.

H.2.3. Reinstalling the WINS Impactor

Follow these steps to reinstall the WINS impactor:

1) **Attach the adapter to the lower section of the WINS impactor.**
2) **Push the WINS impactor (with its adapter attached) upward into the WINS impactor mounting sleeve.**
3) **Pass the rollers of the filter exchange mechanism through the slots in the left-hand and right-hand guides.**
4) **Allow the filter exchange mechanism to open fully.**
5) **Insert the filter cassette carrier (with a filter cassette installed) into the filter platform by matching the slot and hole in the filter cassette carrier with the appropriate hardware.**
6) **Push the handle of the filter exchange mechanism toward the back to install the filter cassette.**

Appendix I: Inlet Conversion

The Partisol-FRM Sampler can be configured with a variety of inlet systems. This appendix describes the components of the PM-2.5 WINS impactor sampler configuration and the PM-10 sampler configuration, and the procedures for converting the Partisol-FRM from a PM-2.5 to a PM-10 sampler.

I.1. Partisol-FRM PM-2.5 Components

This following components comprise the PM-2.5 WINS inlet configuration as shown in Figure I-1.

PM-10 inlet
Sample tube
WINS impactor
WINS adapter

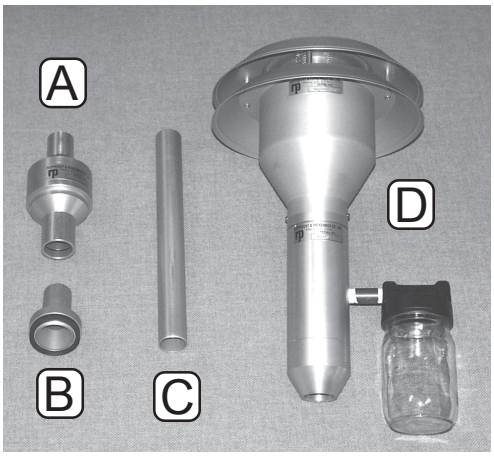


Figure I-1. Partisol-FRM with WINS impactor (A), WINS adapter (B), sample tube (C) and modified PM-10 inlet (D).

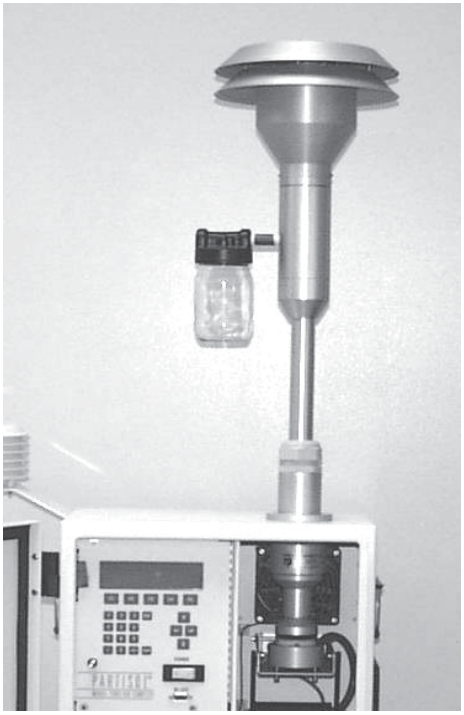


Figure I-2. Partisol-FRM with modified PM-10 inlet and WINS impactor installed.

I.2. PARTISOL-FRM PM-10 COMPONENTS

The following components comprise the PM-10 inlet configuration as shown in Figure I-3.

PM-10 inlet
Sample tube
Straight tube
Straight tube adapter

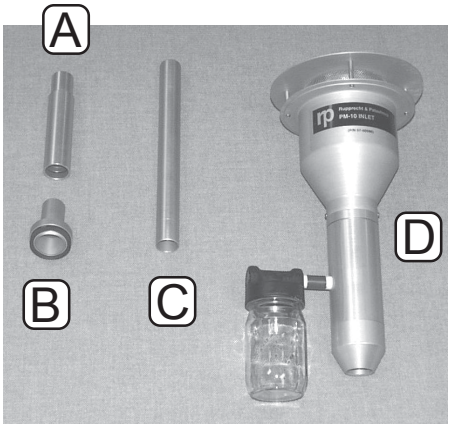


Figure I-3. Partisol-FRM straight tube (A), straight tube adapter (B), sample tube (C) and original PM-10 inlet (D).

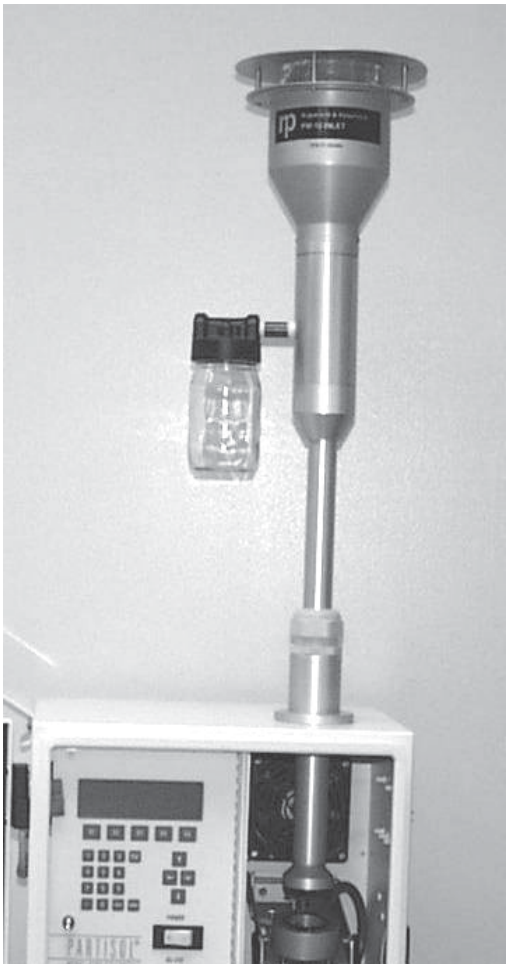


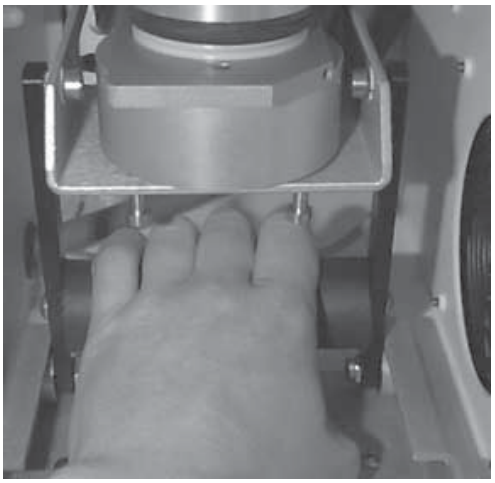
Figure I-4. Partisol-FRM with straight tube and original PM-10 inlet installed.

I.3. Converting the Partisol-FRM from a PM-2.5 Sampler to a PM-10 Sampler

Follow these steps to convert a PM-2.5 sampler to a PM-10 sampler:

1) **Open the Partisol-FRM enclosure door to access the filter exchange mechanism.**
2) **Pull the filter exchange mechanism toward you to open the filter exchange mechanism.**
3) **Lift the rollers through the slots in the left-hand and right-hand guides (Figure I-5).**

Figure I-5. Opening the filter exchange mechanism.



4) **Allow the filter platform to settle downward, and remove the WINS impactor and adapter by pulling them straight downward.**
5) **Remove the PM-10 inlet from the sample downtube by pulling it straight upward.**
6) **Remove the WINS adapter (Figure I-6) from the WINS impactor and attach it to the straight tube.**

Figure I-6. Adapter for the WINS impactor and straight tube.

7) Install the straight tube with the adapter into the Partisol-FRM enclosure by pushing them straight upward until they hit a stop (Figure I-7).

Figure I-7. Straight tube and adapter installed inside the enclosure.

8) Install a filter carrier (with filter cassette) into the filter exchange mechanism and close the mechanism by pushing the handle toward the back of the enclosure (Figure I-7).

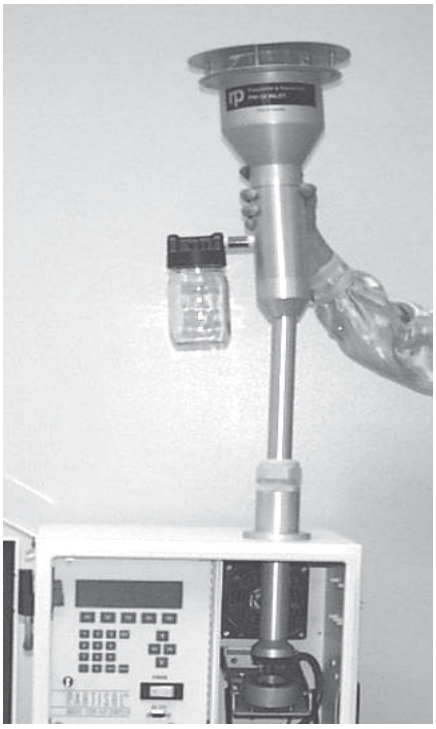
Figure I-7. Filter cassette installed in the sampler.

9) Install the sample tube by pushing it down until it hits a stop.

10) Tighten the bulkhead fitting.

11) Install the PM-10 inlet onto the sample tube (Figure I-8) by pressing it downward until it hits a stop.

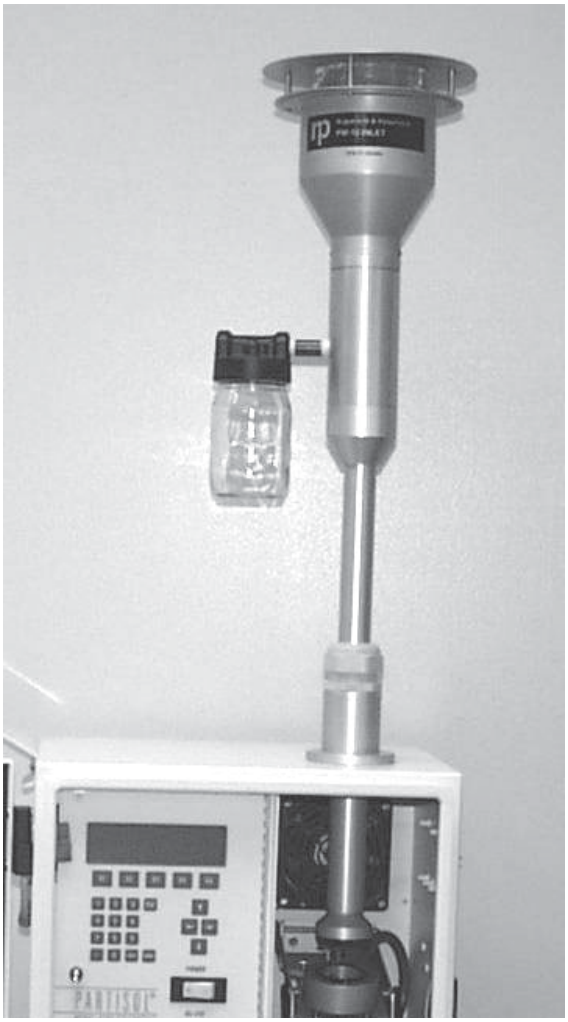
Figure I-8. Installing the original PM-10 inlet onto the sample tube.



12) The Partisol-FRM is now configured as a PM-10 sampler (Figure I-9). There is no difference in sampler programming or operation with the PM-10 inlet installed on the unit.

NOTE: Make sure that the filter cassettes, transport containers and data sheets are clearly labeled as PM-10 sampling filters or sampling data when you install the PM-10 inlet and straight tube onto the Partisol-FRM sampler.

Figure I-9. Partisol-FRM in the PM-10 configuration.

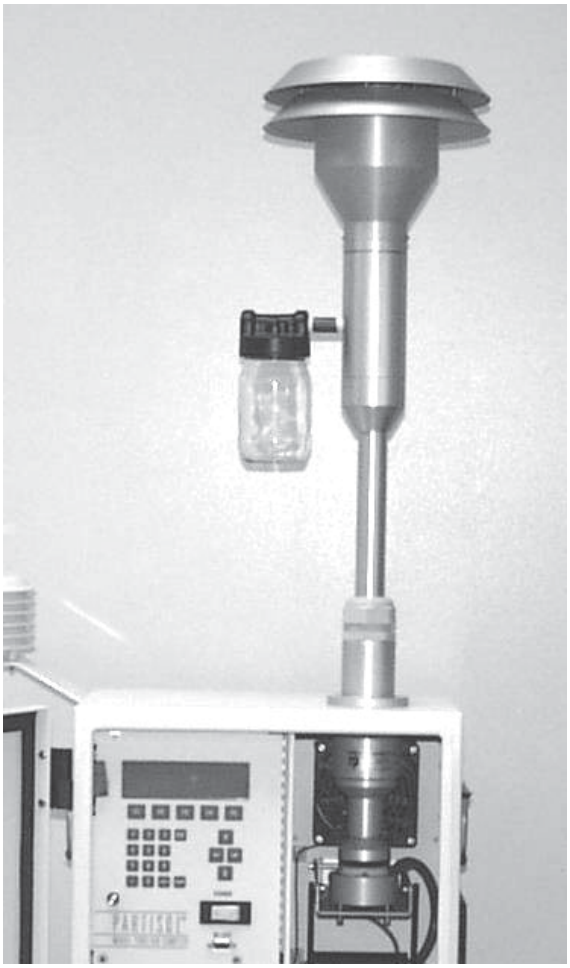


I.4. Converting the Partisol-FRM from a PM-10 Sampler to a PM-2.5 Sampler

Follow these steps to convert a PM-10 sampler to a PM-2.5 sampler:

1) **Remove the PM-10 inlet and straight tube from the sampler.**
2) **Separate the adapter from the straight tube.**
3) **Install the adapter onto the WINS impactor.**
4) **Install the WINS impactor with the adapter into the enclosure by pushing them straight upward until they hit a stop.**
5) **Install a filter carrier (with filter cassette) into the filter exchange mechanism and close the mechanism by pushing the handle toward the back of the enclosure.**
6) **Install the sample tube by pushing it down until it hits a stop.**
7) **Tighten the bulkhead fitting.**
8) **Install the PM-10 inlet onto the sample tube by pressing it downward until it hits a stop.**
9) **The Partisol-FRM is now configured as a PM-2.5 sampler (Figure I-10). There is no difference in sampler programming or operation with the PM-2.5 inlet installed on the unit.**

Figure I-10. Partisol-FRM in the PM-2.5 WINS impactor configuration.



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